139-481

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TRANSCRIPT OF RECORD

SUPREME COURT OF THE UNITED STATES.

OCTOBER TERM, 1890.

No. 232.

THE ELECTRIC GAS LIGHTING COMPANY, APPELLANT,

vs.

THE BOSTON ELECTRIC COMPANY.

APPEAL FROM THE CIRCUIT COURT OF THE UNITED STATES FOR THE DISTRICT OF MASSACHUSETTS.

FILED OCTOBER 14, 1887.

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a UNITED STATES OF AMERICA, *Massachusetts District,* } ss:

At a circuit court of the United States for the first circuit, begun and holden at Boston, within and for the district of Massachusetts, on Friday, the fifteenth day of October, in the year of our Lord one thousand eight hundred and eighty-six, before the Honorable Le Baron B. Colt, circuit judge.

ELECTRIC GAS LIGHTING COMPANY, Complainants,
v.
BOSTON ELECTRIC COMPANY, Defendants. } In Equity.

The bill of complaint in this cause was filed in the clerk's office on the first day of May, A. D. 1884, and was duly entered at the October term of this court, A. D. 1884, and is in the words and figures following:

1 *Bill of Complaint.* (*Filed May* 1, 1884.)

To the honorable the justices of the circuit court of the United States for the district of Massachusetts:

The Electric Gas Lighting Company, a corporation duly organized and existing under and by virtue of the laws of the State of Maine, and having a place of business in Boston, in said district, bring this their bill of complaint against the Boston Electric Company, a corporation duly established and existing under the laws of the State of Massachusetts.

And thereupon your orators complain and say—

1. That upon the twentieth day of August, 1872, Jacob P. Tirrell, then and ever since a citizen of the United States, being the original and first inventor of certain new and useful improvements in electrical apparatus for lighting street lamps, etc., which was never known or used before his invention thereof and which had not at the time of his application been in public use or on sale for two years, made application according to law for letters patent of the United States to be granted to him therefor; upon which application, due proceedings being had in all respects, said letters patent were, on the twentieth day of August, 1872, granted, issued, and delivered to said Jacob P. Tirrell, under the seal of the Patent
2 Office, signed by the Secretary of the Interior, countersigned by the Commissioner of Patents, and numbered 130,770, whereby there was granted and secured to said Jacob P. Tirrell, his administrators or assigns, for the term of seventeen years from said twentieth day of August, 1872, the full and exclusive right and liberty of making, using, and vending to others to be used the said invention or improvements, a description whereof is given in said letters patent and the schedules annexed thereto and forming a part thereof, as by said patent numbered 130,770 or a copy thereof, here in court to be produced, will fully appear.

2. That prior to the twenty-first day of February, 1881, the Franklin Electric Gas Lighting Company became and then was the sole and exclusive owner of said letters patent numbered 130,770 by mesne assignments duly executed, delivered, and recorded.

3. That said Jacob P. Tirrell, for good and lawful cause, by and with the consent and allowance of said Franklin Electric Gas Lighting Company, then afterwards surrendered said letters patent to the Commissioner of Patents, and made due application, complying in all things with the law in such case made and provided, for new letters patent of the United States for said improvements and invention, upon which application, due proceedings being had in all respects, said new letters patent, for the same invention and improvements and in accordance with the corrected specification, were, on the seventh day of June, 1881, issued to said Franklin Electric Gas Lighting Company, as assignee, by mesne assignments, of said Jacob P. Tirrell, under the seal of the Patent Office, signed by the Secretary of the Interior and countersigned by the Commissioner of Patents and numbered 9743 of reissued letters patent, for the unexpired part of the said term of seventeen years of the said original patent numbered 130,770, surrendered as aforesaid, as by said reissued letters patent numbered 9743 and the schedule annexed thereto and forming a part thereof or a copy thereof, here in court to be produced, will more fully appear.

4. That your orators afterwards and on or about the sixth day of May, 1882, became and since have ever been and now are the sole and exclusive owners of said reissued letters patent numbered 9743 and of the inventions and improvements, rights and privi-
3 leges, described therein and secured or intended to be secured thereby, as will more fully appear by assignments duly executed, delivered, and recorded or copies thereof, duly authenticated, here in court to be produced.

5. That the sole right to manufacture, use, and vend to others to be used the said invention and improvements and to enjoy all the exclusive rights and privileges granted and secured or intended to be granted and secured by said letters patent thereby became and still is vested in said The Electric Gas Lighting Company; that the only right granted to or possessed by any other persons under said letters patent has been and is the right obtained by and under the license of said The Electric Gas Lighting Company or its predecessors, according to the terms thereof.

6. That the inventions and improvements so patented and assigned to your orators, as aforesaid, are very valuable and useful to the public and of great convenience and utility in the saving of time, labor, and expense; that the same have been extensively introduced into public use, and that your orator is actively engaged in extending such use; that many hundred electric gas-burners, embracing said inventions, have already been and many more are now being put into public use by your orators, their agents and licensees, the purchases and users admitting the claims of and paying to the owners of said letters patent a reasonable price and compensation there-

for; that the validity of said letters patent has been generally recognized and your orators' exclusive right to the said invention and improvements acknowledged and acquiesced in; that from time to time sundry parties have attempted to make, use, and sell electric gas-lighting apparatus embracing said inventions and improvements, but that upon hearing of the same your orators have notified such parties to desist therefrom, and such parties have generally, upon receiving such notice, complied therewith and recognized as valid the claims of your orators; that your orators have asserted and claimed and, but for the wrongful acts of the defendants and others acting in concert with them or otherwise incorrectly informed as to the said rights of your orators, would have almost universally enjoyed the sole and exclusive right to make, use, and vend to others
4 the said inventions and improvements, and that they have not acquiesced in such wrongful acts of the defendants and others or in any infringement of their exclusive rights; that they have already commenced suit against certain infringers, and are about to proceed against the few remaining infringers; that the exclusive rights as aforesaid of your orators are of great value, and that they would have made large gains and profits therefrom within the district aforesaid but for the wrongful acts and doings of the defendants and the violation by them of the said rights and privileges of your orators.

7. And your orators show that the same inventions and improvements are for use in large part upon small apparatus, easily connected and used in private and easily transferred from one to another, so that it is both extremely difficult for your orators to detect all instances of the use thereof by persons not licensed by your orators, as also to prove the use thereof, and it would be exceedingly burdensome to your orators to bring separate suits against each user to restrain such infringing use; and so if the defendants shall be allowed to continue to manufacture and supply said inventions and improvements your orators will be wholly without adequate remedy in the premises.

8. Yet the said defendants, well knowing the premises and the exclusive rights of your orators as aforesaid, but contriving to injure your orators and to deprive them of the benefit and advantage which might and otherwise would accrue to them from said inventions, improvements, rights, and privileges, without the license or consent of your orators and in infringement of said reissued patent, have, as your orators are informed and believe, made, sold, used and caused to be made, sold, and used electrical gas-lighting apparatus containing or embracing the inventions and improvements secured to your orators in said reissued letters patent, or substantial and material parts thereof, at Boston, State of Massachusetts, and elsewhere within the said district of Massachusetts, and are still making, using selling, or causing to be made, sold, and used the inventions and improvements secured to your orators by said reissued letters patents within said district, and have furnished electrical apparatus containing or embracing said inventions and im-

provements to a considerable number of persons within this
5 district for use in violation of said reissued letters patent, and still continues so to do, but precisely how long the defendants have made, sold, or used or caused to be made, sold, or used or furnished to others to be used the said inventions and improvements or to what extent they have done the same your orators, for want of discovery, do not know and cannot set forth, and they pray that defendants may be compelled to set forth the same in their answer, and have derived and received and are still deriving and receiving therefrom great gains and profits, but to what amount your orators are ignorant for want of discovery and cannot set forth, and they pray that defendants may be compelled to set forth the same in their answer.

9. Your orators have requested the said defendants to acknowledge their rights in the premises, and to desist and refrain from said acts and from disregarding and infringing your orators' said rights, and to account with and pay to your orators what is justly due to your orators by reason of said infringement.

10. But now so it is, may it please your honors, that the defendants wholly refuse so to do, but, on the contrary, continue and threaten to continue said infringement of the rights of your orators aforesaid, and persistently threaten to make and put out other like apparatus containing said inventions and improvements, and thereby cause irreparable injury to your orators' lawful business, all of which is contrary to equity and good conscience.

11. To the end, therefore, that the said defendants may, if they can, show unto your honors why your orators should not have the relief herein prayed, and may, under their seal and the oath of their president or other chief officer and manager, and according to his and their best and utmost knowledge, remembrance, information, or belief, full, true, direct, and perfect answer make to all and singular the matters hereinbefore stated and charged as fully and particularly as if the same were here repeated and they especially interrogated as to each and every of said matters, and more especially may discover and set forth whether during any and what period of time and whether at said Boston or elsewhere and when and where they either made, used, or sold said improvements or any and what of the same and to what extent; whether they within said times
6 and places and when and where made, used, or sold any electrical gas-lighting apparatus or mechanism or any of the various parts thereof and what and to what extent; whether they have made, used, or sold and when, where, and to whom they sold the same gas-burners provided with any apparatus for lighting gas by electricity, and how the said apparatus and the parts of the same are constructed and used; and your orators show that they are entitled to restrain all further use of electrical gas-lighting apparatus containing or embracing the said inventions or improvements which have been or shall hereafter be made and put out by the defendants, and to receive and collect from each user thereof a suitable sum as and for damages and profits in consequence of and growing out of such use by each person who has used the same; and, not waiving

said right, but wholly insisting thereon, your orators aver that the defendants are also liable to pay to your orators other sums as and for profits by them actually realized by and from said infringement and unlawful acts; wherefore your orators pray that the defendants may be decreed to pay over to your orators all such gains and profits resulting to them from said infringement, and may be restrained, together with their officers, servants, and agents, by an injunction to be issued out of this honorable court, according to law in such case provided, from making, selling, using or causing to be made, sold, or used in any manner the said improvements or any electric gas-lighting apparatus containing or embodying or in any way counterfeiting the said invention and improvements described or secured in the said reissued letters patent, and from infringing upon or violating the said reissued letters patent in any way whatever, and that they may be also restrained and enjoined as aforesaid during the pendency of this suit, and that said defendants may be decreed to pay the costs of this suit, and that your orators may have such other and further relief in the premises as the nature of the case may require and to your honors shall seem meet.

May it please your honors to grant unto your orators not only a writ of injunction, but also a writ of subpœna, to be directed to said defendants, commanding them, at a certain time and under affixed penalties therein to be limited, personally to be and appear before your honors and this honorable court, then and there to an-
7 swer unto this bill of complaint, and to do and receive what to your honors shall seem meet in the premises.

THE ELECTRIC GAS LIGHTING COMPANY,
By JOHN N. BARBOUR, *Treasurer.*

EDWARD P. PAYSON,
Solicitor and of Counsel.

UNITED STATES OF AMERICA, }
District of Massachusetts, } *ss:*

BOSTON, *May* 1, 1884.

Then personally appeared John N. Barbour, above named, and he, having been by me first duly sworn, did depose and say that he is the treasurer of said The Electric Gas Lighting Company; that he has read the foregoing bill and knows the contents thereof; that all things therein stated as to the acts of said corporation are true; that all other matters therein stated he believes to be true, and believes said Tirrell to be the true, first, and original inventor of the improvements in said letters patent set forth and claimed, and that the same had not been in public use or on sale two years before his applications for letters patent therefor.

Before me—

[SEAL.] A. E. DENISON,
Notary Public.

This cause was thence continued to the May term, A. D. 1884, when the following answer was filed:

Answer. (*Filed July* 1, 1884.)

This defendant, saving and reserving to itself all and all manner of benefit of exception which may be had or taken to the complainant's bill of complaint on account of its errors, insufficiencies, and uncertainties, for answer thereto or to so much thereof as the defendant is advised it is material or necessary to make answer, says as follows:

This defendant admits that it is a corporation duly established and existing under the laws of the Commonwealth of Massachusetts.

8 The defendant, on information and belief, admits that letters patent of the United States numbered 130,770 and dated Aug. 30, 1872, were granted to Jacob P. Tirrell.

The defendant, on information and belief, denies that said Jacob P. Tirrell was the original and first inventor of the matters and things described and claimed in said letters patent, and alleges that prior to the supposed invention by said Tirrell of said matters and things substantial and material parts thereof or the whole of said supposed inventions were described in letters patent of the United States granted, dated, and numbered as follows:

To Frost and Lawrence, Aug. 8, 1865, No. 49254; reissued to Frost and Lawrence Dec. 20, 1881, reissue No. 9981.

To G. G. Percival, June 15, 1867, No. 61247.

To Edward E. Bean, June 1, 1869, No. 90629.

To Morris and Reid, April 5, 1870, No. 101,491.

To Frank Bean, Oct. 18, 1870, No. 108,434.

To Heyl and Diehl, June 20, 1871, No. 116,054.

To Allen and Dewey, July 4, 1871, No. 116,660.

To J. P. Tirrell, Nov. 28, 1871, No. 121,301.

To J. P. Tirrell, Nov. 28, 1871, No. 121,302.

The defendant has no knowledge whether or not prior to Feb. 21, 1881, the Franklin Electric Gas Lighting Company became the owner of said letters patent No. 130,770, and does not admit that it became such owner, and leaves the complainant to make due proof thereof.

The defendant further alleges, on information and belief, that more than two years prior to the application by said Tirrell for said letters patent substantial and material parts of the alleged invention described and claimed in said letters patent or the whole of said inventions were in public use or on sale in the city of Boston, Mass., and that said use was well known to Edwin E. Bean and Frank Bean, of said Boston, and to George F. Pinkham, of Quincy, Mass.

The defendant, on information and belief, denies that the alleged application for reissue of said letters patent No. 130,770, granted to Jacob P. Tirrell, was made for good and lawful cause and in compliance with the law; but, on the contrary, it alleges that said

9 reissued letters patent were applied for and obtained illegally and contrary to law.

The defendant, on information and belief, avers that said original letters patent No. 130,770 were not inoperative or invalid by reason of such a defective or insufficient specification as was or could be lawfully corrected or amended by the surrender and reissue thereof; that said original letters patent were not surrendered to correct any error which had arisen by inadvertence, accident, or mistake; that new matter, not constituting any substantial part of the alleged invention for which said original letters patent were granted, was introduced and interpolated into the specification and claims of said reissued letters patent; that said reissued letters patent are not for the same invention as were said original letters patent; that said reissued letters patent contain broader claims of invention than were contained in said original letters patent; that said reissued letters patent were not applied for with due diligence after the issue of said original letters patent, and that said reissued letters patent are null and void.

The defendant further alleges on information and belief that said reissue was illegally and fraudulently applied for and was illegally granted by the Commissioner of Patents, that he had no jurisdiction to receive said application for reissue and to grant said reissued letters patent, as set forth in the bill of complaint, and that said reissued letters patent were applied for and granted contrary to the direct expression of the statutes in that case made and provided.

The defendant has no knowledge as to whether or not the complainant has, since the sixth day of May, 1882, been the owner of said reissued letters patent, and it leaves complainant to make such proof of said alleged ownership as it may deem material or necessary.

The defendant, on information and belief and in view of the state of the art in question as the art existed at the time said Tirrell made his said alleged invention as set forth in said original patent No. 130,770 and in said reissued letters patent, denies that the matters and things claimed in said original and reissued letters patent to have been invented by said Tirrell amount to a patentable invention, and the defendant avers that each and all of the said alleged improvements were the product of mere mechanical skill.

The defendant denies that the sole right to manufacture, use, and vend the alleged inventions and improvements claimed to be secured by said reissued letters patent became and is vested in the complainant.

The defendant, on information and belief, denies that said alleged invention and improvements have been of value and use to the public and of great convenience and utility, or that they have been extensively introduced into public use, or that complainant is actively engaged in extending such use, or that any considerable number of electric gas-burners embodying said inventions have been or are being put into use by complainant or by its agents and licensees, or that the validity of said reissued letters patent has been generally recognized and complainant's alleged exclusive right to the inventions and improvements claimed to be secured thereby has

been generally acquiesced in, or that complainant, but for the alleged wrongful acts of this defendant, would have made large gains and profits from the manufacture, use, and sale of said inventions and improvements.

This defendant, further answering on information and belief, denies that it has ever infringed said reissued letters patent; denies that it has ever infringed upon any rights whatever of the complainant; denies the complainant's right to any discovery or to any account of damages, of profits, or to costs to be recovered from this defendant; denies the complainant's right to any injunction, provisional or perpetual, against this defendant, and denies that complainant is entitled to any other or further relief whatever against this defendant.

All of which matters and things this defendant is ready to aver, maintain, and prove as this honorable court shall direct, and it prays to be hence dismissed with its reasonable costs and charges in this behalf wrongfully sustained.

[SEAL.] BOSTON ELECTRIC CO.,
By C. C. ALLEN, *Treas.*

11 COMMONWEALTH OF MASSACHUSETTS, *County of Suffolk,* } *ss:*

BOSTON, *June* 30, *A. D.* 1884.

Then personally appeared C. C. Allen, treasurer of the Boston Electric Company, who, being by me duly sworn, did depose and say that he is the treasurer of said company; that he has read the foregoing answer subscribed by him in behalf of said company and understands the contents thereof, and that the same is true of his own knowledge except as to the matters therein stated on information and belief, and that as to those matters he believes it to be true.

Before me—

JOHN E. ABBOTT,
Notary Public.

On the eighth day of August, A. D. 1884, the following replication was filed:

Replication. (*Filed Aug.* 8, 1884.)

The replication of The Electric Gas Lighting Company, complainant, to the answer of The Boston Electric Company, defendant.

These repliants, saving and reserving unto themselves all advantages of exception to the insufficiencies of said answer, for replication thereunto say that they will aver and prove their bill of complaint in this cause to be true, certain, and sufficient in the law to be answered unto, and that said answer is uncertain, untrue, and insufficient to be replied unto; without this, that any other matter in said answer contained material or effectual in law to be replied unto, confessed and avoided, traversed or denied, is true; all of which these repliants are and will be ready to aver and prove as this hon-

orable court shall direct, and pray as in and by this said bill they have already prayed

By their solicitor, EDWARD P. PAYSON.

This cause was thence continued to the May term, A. D. 1886, when publication of the testimony was had and the cause was set down for hearing and fully heard, and was thence continued under advisement to this present term, when the opinion of the court is given, and on the second day of February, A. D. 1887, the following decree is entered:

Decree. (*February* 2, 1887.)

This cause came on to be heard at the May term, 1886, and was argued by counsel, and now, to wit, this second day of February, 1887, upon consideration thereof and in accordance with the opinion of the court filed December 24, 1886, it is ordered, adjudged, and decreed that the bill of complaint be, and hereby is, dismissed with costs to the defendant, taxed at one hundred one and $\frac{70}{100}$ dollars ($101.70), and that the defendant have execution therefor.

From this decree the complainants claim an appeal to the Supreme Court of the United States, and give good and sufficient security that they will prosecute their appeal to effect and answer all damages and costs if they fail to make their plea good and said appeal is allowed.

A true record.

JOHN G. STETSON, *Clerk.*

12 The following is the evidence used at the hearing of said cause before said circuit court:

Evidence for Complainants.

Taken pursuant to the sixty-seventh rule of the Supreme Court of the United States, in equity, as amended, before me, William E. Spear, special examiner.

BOSTON, MASS., *Nov.* 3, 1885.

Present: Edward P. Payson, Esq., of counsel for complainants; John E. Abbott, Esq., of counsel for defendants.

Counsel for complainants puts in evidence copies of the following letters patent: (1)—being the letters patent in suit—reissue letters patent No. 9743, dated June 7, 1881, granted to the Franklin Electric Gas-Lighting Company, assignee of Jacob P. Tirrell, which is marked "Complainants' Exhibit Tirrell Reissue;" (2) letters patent No. 130,770, granted Aug. 20, 1872, to J. P. Tirrell, and marked "Complainants' Exhibit Tirrell Original;" (3) letters patent to Samuel Gardiner, Jr., No. 55642, granted June 19, 1866, and marked "Complainants' Exhibit S. Gardner, Jr.;" (4) letters patent No. 22952, granted Feb. 15, 1859, to W. W. Hopkins, and marked "Complainants' Exhibit W. W. Hopkins;" (5) letters patent No. 29254, granted Aug. 8, 1865, to Edward J. Frost and George A.

Lawrence, and marked "Complainants' Exhibit E. J. Frost and G. A. Lawrence Original;" (6) letters patent No. 73868, granted Jan. 28, 1868, to Frank Bean, assignor, and marked "Complainants' Exhibit Frank Bean;" (7) letters patent No. 90629, granted June 1, 1869, to Edwin E. Bean, and marked "Complainants' Exhibit Edwin E. Bean;" (8) letters patent No. 108,434, granted Oct. 18, 1870, to Frank Bean, and marked "Complainants' Exhibit Frank Bean;" (9) letters patent No. 101,491, granted April 5, 1870, to W. J. Morris and W. J. Reid, and marked "Complainants' Exhibit Morris and Reid;" (10) letters patent No. 121,301, granted Nov. 28, 1871, to J. P. Tirrell, and marked "Complainants' Exhibit J. P.
13 Tirrell;" (11) letters patent No. 121,302, granted Nov. 28, 1871, to J. P. Tirrell, and marked "Complainants' Exhibit J. P. Tirrell."

It is stipulated between said counsel that above copies have the same force and effect as if certified.

Counsel for complainants further offers in evidence assignments, Franklin Electric Gas Lighting Company to the National Electric Gas Lighting Company, recorded United States Patent Office June 13, 1883, of said Tirrell reissue patent; National Electric Gas Lighting Company to the Electric Gas Lighting Company, dated May 6, 1882, recorded United States Patent Office May 17, 1882, of said Tirrell reissue patent; Jacob P. Tirrell to the Electric Gas Lighting Company, dated Nov. 11, 1882, recorded United States Patent Office Nov. 20, 1882, of said Tirrell reissue patent. Said original assignments having been examined by counsel for the defendants, it is stipulated and agreed that the allegations of title in complainants' bill of complaint are admitted, and further proof thereof and introduction of any assignments are fully waived by defendants.

The incorporation of the plaintiff is hereby admitted on this record. It is hereby admitted that since Nov. 11, 1882, and prior to the commencement of this suit the defendants have made and sold within the district of Massachusetts gas-lighting apparatus similar to the article now produced and offered in evidence and marked "Complainants' Exhibit Defendants' Burner, W. E. S., Sp'l Ex'r, Nov. 3, 1885."

Deposition of Cyrus F. Brackett.

Direct examination by EDWARD P. PAYSON, Esq., of counsel for complainants:

BOSTON, *Nov.* 3, 1885.

Int. 1. What is your name, age, residence, and occupation?

Ans. My name is Cyrus F. Brackett; age, fifty-two years; I reside in Princeton, New Jersey, and am Henry professor of physics in the College of New Jersey, there located.

Int. 2. Please state your qualifications as an expert, both
14 as to the construction and operation of mechanism and as to electrical operation and apparatus.

Ans. For about thirty years I have been engaged in teaching mat-

ters pertaining to physics and chemistry in which the use of mechanical and electrical appliances has been constantly involved. I have frequently had occasion to devise, construct, and repair, not only such apparatus as is usually found in cabinets of physical apparatus, but such as was needed from time to time in the process of experimentation and inquiry into new matters, for whose elucidation no apparatus had been previously existing; further, I have had constantly in my charge and use a large, expensive, and well-selected collection of apparatus adapted to the use of physical laboratory, in which inquiries are constantly made pertaining to the subjects usually embraced in courses of physics as taught in our larger institutions. I have frequently had occasion with my own hands to construct apparatus of my own invention, and I have constantly at my command a machine shop, employing skilled mechanics for carrying out such further devices as physical inquiry from time to time shall suggest or demand.

Int. 3. Have you been called to give testimony as an expert in courts of the United States in patent causes concerning the construction and mode of operation of electrical and mechanical devices and the physical law relating thereto?

Ans. I have frequently.

Int. 4. Have the principles and mode of operation of telegraphic, telephonic, and electric lighting devices been involved in several of such causes in which you have been called?

Ans. They have.

Int. 5. Are you familiar with the history and development of the art of lighting gas by electricity, the mechanism utilized therefor, and the general course of invention therein?

Ans. I am.

Int. 6. Referring to the facts within your own knowledge, and such publications, either patents or text books, as you may desire, will you please state what was the state of the art of electric gas lighting by automatic electric apparatus before the granting of letters patent to J. P. Tirrell, Aug. 20, 1872, No. 130,770, being Complainants' Exhibit Tirrell Original?

Ans. It had long been known that inflammable gas could be ignited by means of an electrical spark, as in the well-known experiments of Franklin and other early electricians. It has also long been known that gas could be lighted by means of a metallic wire or other conductor rendered incandescent by the passage of a current of electricity. In order to employ either of these methods for automatic gas lighting some means must be employed for letting on the gas to be ignited at or about the same time they are called into play. In order to do this it has been the practice of inventors to modify in some way gas cocks or valves so as to bring them under control from a point at a distance from their location. This may obviously be done by employing any of the devices well known in pneumatics suitable for such purpose, such as lifting, falling, sliding, rocking, or revolving valves, this last fitted with ratchet and pawl. In the patent granted to S. Gardiner, 1857, and referred to—Complainants' Exhibit S. Gardiner, Jr.—is employed a ratchet and pawl

actuated by the armature of an electro-magnet in a circuit including a platinum wire, which by incandescence ignites the gas when turned on by the action of a magnet. So also in a patent granted to W. W. Hopkins, 1859, and referred to—Complainants' Exhibit W. W. Hopkins—a valve is held against its seat so as to shut off the gas by the action of a permanent magnet, which is hollow and forms a part of the gas-pipe; but the valve being of iron is also in the centre of the helix, through which a current of electricity can be sent in either direction from a distant station. It may consequently be magnetized temporarily in either sense—that is, it may have its polarity reversed. Thus the wave may be attracted and held against its seat or it may be repelled from its seat, so as to admit the gas, which is at the same time ignited by a small incandescent wire, forming a part of the circuit.

In a patent granted to Frost and Lawrence, 1865, and referred to—Complainants' Exhibit E. J. Frost and G. A. Lawrence—is employed a rocking valve with a stem or valve actuated by an electro-magnet to turn the gas on or off by means of the same current which ignites it by heating a wire located at the burner tip. In all
16 these we find only a continuous current employed. A patent was granted to Frank Bean, 1868, and referred to—Complainants' Exhibit Frank Bean—which employs an armature driving a pawl against a ratchet, opening a gas-cock, while a secondary coil surrounding the primary sends a jumping spark across the space between fixed electrodes properly placed — ignites the gas. This apparatus, by reason of the power of the secondary spark, may be employed to light several jets at once. A patent granted to E. E. Bean, 1869, and referred to—Complainants' Exhibit E. E. Bean—shows an armature, pawl, ratchet, and gas-cock, as in patent granted to Frank Bean, previously referred to, with an automatic circuit-shifter and wires, one to turn on the gas and one to turn it off, and employing a jumping spark. Bean patented October, 1870, an apparatus employing pneumatic power to turn the gas on and off and to break a primary circuit, thus producing a spark to ignite the gas. Here we have the first compound circuit-breaker.

Electricity has long been known as capable of actuating a mechanical contrivance to effect actions at a distance, and so must be regarded as a known equivalent for pneumatic power. Hence it could be substituted for pneumatic power in effecting such actions as might otherwise be produced by the latter power in turning on or off the gas or breaking a circuit in automatic gas-lighting apparatus without essentially changing the underlying idea.

Morris and Reid, in a patent granted in 1870 and referred to—Complainants' Exhibit W. J. Morris and W. J. Reid—employed three circuits, one to turn on the gas, one to light it, and one to turn it off.

In a patent granted to J. P. Tirrell, 1871, and referred to—Complainants' Exhibit J. P. Tirrell—is employed shifting mechanism, so as to bring the full power of the battery to bear upon one lamp at a time, as had been done by Bean, 1869. This he accomplished by the use of cam wheels and contact pins so placed as to divert the

current from a given lamp to a succeeding one in the series. In these patents I find a state of the art, as called for in the question, prior to 1872.

To recapitulate, I mention the following devices employed in automatic gas-lighting apparatus: Apparatus in which a magnet opens a gas cock or valve by either a sliding, lifting, or turning motion to admit the gas; and, second, arranged so as to act at
17 or about the same time a current of electricity is made either to heat a metallic conductor to ignition or to pass at the tip of the burner between two stationary electrodes, so as to ignite the gas, after which, actuated either by the same magnet which was employed to turn on the gas or by another magnet, an armature is made to shut it off. Shifting mechanism, in case it is desired to light in series, has also been devised, so as to be operated by the same power which moves the gas-cock. I find as a substitute for magnetic power a pneumatic device to turn on and off the gas and to break the circuit producing a spark.

Int. 7. Have you read letters patent No. 130,770, being Complainants' Exhibit Tirrell Patent Original, and do you understand the same and the invention therein set forth?

Ans. I have read and believe I understand the invention referred to.

Int. 8. Will you compare the invention therein set forth with such automatic electric gas-burners as you have referred to in your last answer but one and state what similarities and dissimilarities you find as the result of such comparison?

Ans. I find that this patent discloses an invention in which a single current of electricity or a current traversing a single conductor is made to act upon an electro-magnet so arranged as to operate a gas valve or cock to let on the gas and at the same time to rupture a circuit, so as to produce a primary spark situated at the tip of the gas-burner in order to ignite the gas so turned on; and in case it is desired to operate so as to light several lamps in succession switching mechanism is provided whereby the full power of the battery is brought to bear upon each. The same current which actuates the gas-cock is utilized for producing a spark. I do not find in any prior invention that this has been accomplished.

Int. 9. Referring to claim 1 of said patent, will you please explain the devices and their method of operation therein referred to?

Ans. I find a wire conveying a current of electricity, an electro-magnet joined with such wire, an armature actuated by the magnet, electrodes situated at the burner tip and in the circuit which
18 traverses the magnet, and so arranged that they can be separated by the action of the armature, thus producing a spark which ignites the gas.

Int. 10. Will you state what reasons you have for finding such to be the physical construction of the automatic circuit-breaker therein referred to?

Ans. I find, first, that circuit-breakers as such and simply considered were old, and could not, therefore, properly be patented; and, secondly, by reference to the embodiment of the specification as

referred to in the words substantially as described, I find the device consisting, as I have set forth, of the wire conveying the current, the magnet, the armature, and the electrodes constituting the circuit-breaker.

Int. 11. Referring to claim 2 of said patent, will you please explain the devices and their method of operation therein referred to?

Ans. The device referred to in claim 2 is what has just been set forth in combination with a lever adapted and arranged to open and close the stop cock or valve, and carrying a circuit-breaker. The operation I understand to be as follows: When a current of electricity traverses the circuit, consisting, as I have said, of the wire magnet (by which I mean its helix) and the electrodes constituting the circuit-breaker, the armature is attracted and made to move the gas-cock, which, in the drawings of this invention and in the description, is actuated by pawl and ratchet, and also is made to rupture the circuit at the tip of the burner, thereby producing a spark, and in this case successive sparks, by which the gas is inflamed.

Int. 12. Could a device embodying a circuit-breaker as explained and a lever, and no more, constitute a device of any more utility in an automatic electric gas-burner than a circuit-breaker alone?

Ans. It would not.

Int. 13. Taking the subject-matter of claim 1 and the subject-matter of claim 2 together, what is the construction and mode of operation of such combination of mechanism?

Ans. It would consist of a wire conveying a current joined
19 to one end of the helix of an electro-magnet, whose other extremity is joined to one member of a circuit-breaker, while the other member is so joined as to complete the circuit of the battery or other source of electricity when the contact button or switch is properly operated; of an armature actuated by the electro-magnet and adapted to open and close the gas cock or valve and at the same time, by which I mean by one operation of the button, to break the circuit at the burner tip by means of a lever or its equivalent, thereby igniting the gas, which will be by the same operation turned on by means of the gas cock or valve, which is also a part of the same mechanism.

Int. 14. If it is desired to utilize a series of such devices for the purpose of obtaining nearly simultaneous ignitions of several electric gas-burners do you find any means therefor pointed out in this patent No. 130,770?

Ans. I do. In addition to the apparatus I have described the inventor employs a circuit-shifting device, by means of which the battery current may be made to operate upon a number of burners, each constructed like the others, one at a time; and for this purpose the current is thrown, after lighting any given burner, into a circuit actuating the next in series, and so on till the last of the series.

Int. 15. With a single burner, such as that of which you have explained the construction and operation in your last answer but one, would such shifting device be essential?

Ans. It would not, for clearly the last in any given series is in

the same position relatively to its predecessor as any single one would be in reference to its operating button or key.

Int. 16. Would any mechanical modification of the gas-letting-on mechanism be desirable or possible for the use of such single burner?

Ans. It would certainly be possible by the use of such devices only as have hitherto been pointed out in the course of this examination. Under certain circumstances it would be desirable, doubtless, to introduce such modifications. There are uses, however, to which this apparatus might be put, and modes of operating it, in which no such modifications would be needed.

Int. 17. Will you please state a little more in detail what you have alluded to in your answer to the last question?

20 Ans. Since the apparatus, as constructed with the switching mechanism appended, would not only turn on the gas and light it, but would continue to turn the stop-cock so as to shut off the gas, it would be adapted to the production of an intermittent light without any further care from the operator than is involved in closing the circuit and keeping it closed; hence for such purpose no modification would be needed; second, without modification it could be employed for lighting any single light visible to the operator by merely pressing the key till such lighting is accomplished; third, with a nearly constant battery or other source of electricity gas might be fully turned on and lighted without being turned off by merely holding the circuit closed at the key for a suitable time; but if modifications were desired to render the apparatus operative for single lights without special care or observation it would only be necessary to modify the cock or valve by making use of any of the well-known devices for such purposes, with suitable adjustment of the magnet, or, in case it were more convenient, by its duplication.

Int. 18. From the date of patent No. 130,770 down to June, 1881, will you state, so far as the matter is within your own knowledge or contained in publications of any kind with which you are familiar, what other and different mechanism, both in construction and mode of operation, from that set forth in said patent No. 130,770 had been devised or used, if any, and what, if any, modifications of the apparatus of said patent No. 130,770 had been devised or used?

Ans. So far as I know, all modifications or improvements brought to light between the dates mentioned in the question consist in substitution of equivalents; such as change in the form of gas-cocks, change in the form and arrangement of levers, change in the shape and disposition of armatures, or changes in the arrangements and number of the magnets employed; in short, mere changes of details, while the apparatus as a whole, in the various cases referred to, has been based upon and has embodied the underlying idea of the apparatus set forth in said patent No. 130,770.

Int. 19. Have you read and do you understand reissue patent No. 9743, being Complainants' Exhibit Tirrell Reissue, and
21 do you understand the construction and operation of the subject-matter thereof?

Ans. I have read it and believe I understand it, as well as the subject to which it pertains.

Int. 20. Will you please compare the construction and mode of operation of the subject-matter of claim 5 of said reissue with the subject-matter of claim 1 of the original letters patent No. 130,770, and state what similarities or dissimilarities you find in the construction and mode of operation of the several devices of said two claims?

Ans. Claim 5 of said reissue sets forth: "In an apparatus for lighting gas by electricity, the combination of a wire through which a current of electricity is passed, actuating mechanism for letting on gas, an electro-magnet electrically connected with said wire, an armature operated by said electro-magnet, mechanism actuated by said armature, breaking the circuit at the burner tip and producing there electric spark or sparks for lighting the gas, the whole operating automatically." We have, therefore, a wire conveying a current of electricity, an electro-magnet electrically connected with the wire, an armature, a circuit-breaker so connected and arranged as to let on the gas and ignite it by a spark. I find, therefore, the four things enumerated which were enumerated under claim 1 of the original and operating in the same manner as has been previously pointed out in considering that claim. The claims are, therefore, in my opinion, substantially identical.

Int. 21. Will you please compare claim 4 of said reissued patent No. 9743 with claim 2 of the original Tirrell patent No. 130,770 and state what similarities or dissimilarities you find in the construction and mode of operation of the devices set forth in said several claims?

Ans. Claim 4 of said reissue sets forth: "In an apparatus for lighting gas by electricity, in combination with a circuit-breaker located at the gas-burner, a lever adapted and arranged to open and close the stop cock or valve of the burner, and carrying the circuit-breaker, substantially as herein described." There is, therefore, involved the same elements as set forth in claim 1 in combi-
22 nation with claim 2 of the original, to wit, a wire conveying a current, an electro-magnet operating an armature, a stop-cock to be operated by said armature, a circuit-breaker likewise operated by the agency of a lever actuated by said armature, the whole arranged and operating as previously set forth, as when considering those claims, namely, to turn on the gas and ignite it at the burner tip.

Int. 22. Will you please examine Complainants' Exhibit Defendants' Burner and compare the same with claim 5, Tirrell reissue No. 9743, and the device and mechanism therein set forth, and point out what similarities or dissimilarities in the construction and operation you find between said burner and said claim 5 and the device and mechanism therein set forth?

Ans. In the apparatus shown me I find a wire adapted to convey a current of electricity, electrically connected with an electro-magnet, an armature adapted to be operated by said electro-magnet, and a circuit-breaker arranged to be operated by a lever, which in this case is identical with the armature, constituting it an armature lever,

the circuit-breaker being located at the tip of the burner suitably for lighting the gas. These several items I find mentioned in claim 5, alluded to in the question.

Int. 23. Is there or not any substantial difference in the mode of operation of the parts of defendants' burner which you have enumerated and the device of claim 5 of said reissue as you have explained the same?

(Objected to as leading and as incompetent.)

Ans. I find no difference in the mode of operation of the burner shown me and that which I understand to be set forth in claim 5.

Int. 24. Will you please answer the same question as to the mechanism merely of said burner and said claim?

Ans. I discover no essential difference between the said mechanism shown me in said burner and that set forth in said claim.

(Adjourned.)

Nov. 4, 1885.

Int. 25. Will you please compare Complainants' Exhibit Defendants' Burner with the apparatus of reissue claim 4 of patent No. 9743 and state what similarities or dissimilarities, both in the mode
23 of operation and in the mechanical construction, you find between said exhibit and the apparatus of said claim?

Ans. I find in the apparatus alluded to as defendants' burner a circuit-breaker located at the gas-burner, an armature lever which can open the gas-cock, and a second similar one which can close it, the one which opens it being adapted to operate the circuit-breaker so as to produce a spark at the tip of the burner. The armatures are operated by electro-magnets, one of which is in the same circuit with the circuit-breaker. There is also a gas-valve, as already implied, which can be turned through a small arc by a rocking motion produced by the armature lever, the motion being sufficient to admit or turn off the gas. The armature and the lever in this apparatus are both combined in one piece of metal, constituting, as I have called it, an armature lever. The circuit-breaker is not continuous with the armature lever, but arranged so as to be carried by it a small distance only, near the end of its motion toward the magnet. In all essential particulars the apparatus set forth in claim 4 is found in the burner shown me as defendants' burner; likewise, in all essential particulars, the operation of one would be like that of the other if the apparatus set forth in claim 4 were constructed in accordance with the requirements of said claim.

Cross-examination by JOHN E. ABBOTT, Esq., of counsel for defendants:

Cross-int. 26. Have you ever examined the printed record on the part of complainants and also of the defendants in a suit in equity, brought in the United States circuit court for the southern district of New York, between the Electric Gas Lighting Company (the complainants in the suit in which you are testifying) and Luther G. Tillotson *et al.*?

Ans. I have examined the record alluded to in the question.

Cross-int. 27. Have you carefully read the testimony of Messrs. Park Benjamin, Henry Morton, and A. Livingston Brogart, contained in said record?

Ans. I have carefully read the testimony of the first two; not so carefully read the testimony of the latter gentleman.

Cross-int. 28. Have you ever seen an electric gas-lighting
24 apparatus constructed exactly like that illustrated in the drawing of said Tirrell patent No. 130,770, or so nearly like said drawing that the different parts shown in the drawing could each be readily located in such apparatus as you have seen?

Ans. I have.

Cross-int. 29. Where and when?

Ans. I think I have seen such apparatus at the shop of L. G. Tillotson & Co., New York city. As to the date I cannot be positive, but my recollection is that in a collection of such apparatus of different forms and devices I have seen it at various times during some years past, when I have had occasion to visit the shop referred to. I have never to my recollection examined it there with any great care. I have seen it within comparatively few days in the city of Boston.

Cross-int. 30. Will you please examine the apparatus now shown you, and state whether, in your opinion, it is constructed in conformity with the specification and drawings of said patent No. 130,770?

Ans. In all important particulars it appears to be, though there are some deviations in form of some of the parts therein shown. They are such, however, as would readily be recognized as equivalent to those shown in the drawing.

Cross-int. 31. Referring specially to claim 3 of the patent No. 130,770, will you please state what elements specified in that claim you find in the apparatus just shown you, and whether or not those elements, in their arrangement and connection, correspond substantially with those shown in the drawing of said patent?

(Objected to for irrelevancy and as relating to matter not testified to on direct examination.)

Ans. I find the arms O Q, the sector wheels *f* and *n*, the wires M and N, the magnet E, lever H, armature G, circuit-breaker J, pawl S, and ratchet wheel R. The pins *l* and l^2, *m* and m^2, are not present, but are replaced by metallic springs, evidently having the same function. The arrangement and connection appear to be substantially the same as that presented in the drawing.

(Said apparatus has the figures "75" stamped on the face of the ratchet wheel and on sundry other parts, and is marked for
25 identification by a tag attached thereto on which is written "Tirrell 1872 burner, W. E. S., examiner, Nov. 4, 1885." It is agreed between counsel that apparatus is constructed in substantial conformity with the specifications and drawings of said patent

No. 130,770, and the apparatus is now offered in evidence by defendants and is marked " Defendants' Exhibit No. 1.")

Cross-int. 32. Referring to the first claim of patent No. 130,770, will you please state whether you understand that said claim covers a combination of elements or not?

Ans. I understand that it does.

Cross-int. 33. Please state what elements make up the combination which you understand is covered by said claim, giving in your enumeration of those elements the letter by which each is distinguished in the specification or drawings of said patent.

Ans. I understand that the claim involves the wire M, called the letting-on wire, the electro-magnet E, an armature, G, and a circuit-breaker, J K.

Cross-int. 34. Would the device covered by said claim and composed simply of the elements you have designated in your last answer be operative for the purpose of breaking the electric circuit at the burner tip?

Ans. When a current of electricity is sent through the wire and electro-magnet and circuit-breaker, all in the same circuit, the magnet becomes active and the armature is attracted, and by its motion may break the circuit, provided it be connected with the circuit-breaker directly as an armature lever or by a separate and distinct lever; without such connection or its equivalent the circuit will not be broken and the device will be inoperative.

Cross-int. 35. The words " substantially as described " at the end of said claim 1 refer, do they not, to the specification and drawings of said patent?

Ans. Undoubtedly.

Cross-int. 36. In view of those words the circuit-breaker named in said claim 1 would require to make it operate automatically the lever H, would it not?

Ans. No doubt it would, or its equivalent. My reason for
26 not enumerating it with the other elements is that I find it specifically mentioned in claim 2. The words " substantially as described " may call for it, for aught I see.

Cross-int. 37. I wish now to call your attention to the claims of said patent No. 130,770 and of the reissue No. 9743. Claim numbered 3 in the reissue is identically the same, excepting the omission of the letter R after " ratchet wheel," as claim 3 of the original, is it not?

Ans. It is.

Cross-int. 38. What claim, if any, in the reissue corresponds precisely with claim 1 of the original?

Ans. As I understand it, claim 5 embraces the same things as claim 1, though not in precisely the same terms, being more fully expanded.

Cross-int. 39. What claim, if any, of the reissue corresponds precisely with claim 2 of the original?

Ans. Claim 4 seems to me to involve the same matters, it being remembered that claims 1 and 2 are to be read in combination.

Cross-int. 40. Do the other claims of the reissue cover what is specifically claimed in any one of the three claims of the originals?

Ans. In my opinion, only in a general sense, and for another purpose than to claim the specific mechanism involved in the apparatus.

Cross-int. 41. Was not the principal purpose of the invention described and claimed in patent No. 130,770 declared by the inventor to be "for lighting street lamps in which the current is successively thrown into the magnet at each burner one after another"?

Ans. That is undoubtedly the language he employs in the second paragraph of the specification. It is, however, in my opinion, not confined to street lamps, for in the first paragraph he expressly declares that he has invented "certain new and useful improvements in electrical apparatus for lighting street lamps, etc.," and I understand "etc." to apply to any use for which the apparatus may be adapted.

Cross-int. 42. In the apparatus described both in the original patent No. 130,770 and the reissue No. 9743 is not the gas-cock
27 so arranged as to be rotated in one direction only for the purpose both of letting on and turning off the gas?

Ans. Undoubtedly the description and drawings in both patents set forth such an arrangement, which, however, is not so specific in the claims, as I understand them. These latter would admit some variation in the construction by which such continuous rotation would not be necessary.

Cross-int. 43. Please refer to claim 4 of said reissue and state whether or not the words "carrying the circuit-breaker" contained in said claim refer to the lever therein named.

Ans. I understand them to refer to the lever as implied in the question.

Cross-int. 44. Claim 5 of said reissue omits the words "substantially as described," which are contained in claim 1 of the original patent. Do you understand that said claim 5 is broader in its construction than if it contained the three words with which claim 1 of the original concludes?

Ans. I do not think it is broader, and my reason is that claim 5 specifically names the things referred to, as I understand it, in said claim 1 by the words quoted, "substantially as described," which words I understand to refer to those portions of the description without which the apparatus would be entirely inoperative for any purpose involving automatic gas-lighting.

Cross-int. 45. Does not this claim require that the mechanism of the apparatus covered by it should be substantially the same mechanism as that set forth in the specification and drawings of the original patents?

Ans. No doubt it does; but I do not understand that the requirements of this claim can only be met by an apparatus having the precise form and arrangement of all subsidiary parts which are shown in the drawings and described in the specification of the patent, and my reason is that the phraseology employed is: "In an apparatus for lighting gas by electricity, the combination of a wire

through which a current of electricity is passed, etc.; * * * an electro-magnet electrically connected with said wire; an armature operated by said electro-magnet," and that this form of expression leaves it at the option of a constructor to vary from the pre-
28 cise form shown in the drawings in the form and disposition of the various parts employed, provided only they be so shaped and arranged as to perform the functions which are performed by the corresponding parts shown in the drawings and described in the specifications. In other words, any apparatus which involves like parts with those named in claim 5 and acting in like manner would be a substantial embodiment of claim 5; by like I mean equivalent in form and action.

Cross-int. 46. Does the phraseology of claim 5 afford the constructor of the apparatus therein claimed wider scope than the phraseology of claim 1 of the original, in your opinion?

Ans. I do not think it does.

Cross-int. 47. Said claim 5 contains in the third and fourth lines thereof the following phrase: "Actuating mechanism for letting on the gas." What, in your opinion, does this phrase refer to?

Ans. I understand the phrase to be adjunctive and to refer to the function of the current of electricity in letting on the gas through some mechanism not distinctly described in this claim.

Cross-int. 48. But such mechanism must be substantially the same as that described in the specification of the reissued patent, must it not?

Ans. Undoubtedly; understanding by the words "substantially the same" to be meant as to function or operation in turning on the gas. I do not understand that the constructor would not be at liberty to employ any device which might be known to him, such as any of the forms of valves which I have hitherto described in direct examination or any equivalent, provided it was adapted to be moved by the armature so as to let on the gas.

Cross-int. 49. Please specify each of the elements composing the combination which you understand to be included in claim 5 of said reissue, distinguishing each element in your answer by letter of the corresponding part in the drawings of the patent.

Ans. The wire M, the magnet E, the armature G, and the circuit-breaker J K.

Cross-int. 50. The mechanism for letting on the gas which is illustrated in the drawings of the patent and in Defendants' Exhibit No. 1 requires, in addition to the elements you specified in your last answer, the lever H, pawl S, and the ratchet wheel R, does it not?

29 Ans. It does.

Cross-int. 51. Without the switching mechanism shown in said drawings and contained in said exhibit would it be practicable, in your opinion, to use the apparatus for automatically turning on and lighting the gas when the burner which it was desired to light was not within the view of the operator?

Ans. It might be. Such use would only require that the battery or other source of electricity should be of constant electro-motive

force, and that contact at the switching button be made for a definite period of time, sufficient to accomplish the object in view. Both these requirements could be met in practice.

Cross-int. 52. If the contact button should chance to be pressed a trifle too long the gas would be either partly or wholly turned off, would it not?

Ans. Undoubtedly.

Cross-int. 53. Assuming that the burner to be lighted was situated in an adjoining room, out of your sight, and forty feet from where you sit, and that the apparatus, like that shown in Defendants' Exhibit No. 1 (excepting that the switching mechanism were removed therefrom) should be properly located at that burner and suitable connection made with a battery at your side suitably charged, will you please state, as nearly as you can, for what length of time it would be necessary for you to press the contact button in order to turn on and light the gas at said burner without turning off the gas?

Ans. An answer can only be given to the question in general terms, but it would be easy in the cases supposed to ascertain the proper period during which contact must be maintained, and also to arrange the contact key so as definitely and certainly to secure the result. For instance, one member of the contact key might be made to slide, roll, or rest in contact with the other member by the action of gravity or a spring for such length of time as experiments should show to be necessary. It would merely require the action of a constant force to move a weight or its equivalent through a definite distance, which could easily be ascertained by experiment.

As to the definite interval of time required in the given case I should be unwilling to state unless the question gave some definite strength of battery and furnished all the conditions on which the operation depends. I should certainly expect that the interval of time might be measured in seconds, so that the key might reasonably be actuated by a second's pendulum. The interval would certainly be long enough to be definitely under control.

Cross-int. 54. Would there, in your opinion, be any practical difficulty in the ordinary use of such an apparatus in a dwelling-house in securing a constant electro-motive force from day to day and without the exercise of anything more than the average skill and knowledge of ordinary persons?

Ans. As to the first part of the question the answer is, there would not be any practical difficulty. As to the second part of the question the answer is that with a simple press button, in which contact is made by pressure of the hand, the apparatus, as supposed, would not be the most convenient or certain in its operations if it was to be operated at different times by different persons; but with the key arranged as I have pointed out it would, I think, perform its office with satisfaction.

Cross-int. 55. In Defendants' Exhibit No. 1, assuming that the proper connection has been made with the battery, is not this a correct statement of the mode of operation of the apparatus: The electric current passes over one of the wires and thence through proper

connections to the helix of the magnet, which attracts the armature to which the lever which carries the circuit-breaker is attached, and simultaneously the ratchet wheel attached to the gas-cock is rotated and the circuit is intermittently broken and closed near the burner tip?

Ans. Substantially this is the action, though I should prefer to state in addition that the current passes from the other end of the helix through the circuit-breaker and thence to ground. With this addition I believe the statement is substantially correct, with the exception that the word "simultaneously" implies that two actions—which, I believe, are successive, namely, rotation of the cock and breaking of the circuit—occur at one and the same time.

Cross-int. 56. The circuit-breaker J and the pawl S, "which
31 pawl actuates the ratchet wheel," are both attached to the lever H, are they not?

Ans. They are.

Cross-int. 57. In Defendants' Exhibit No. 1 would not a spark be produced at the burner tip when the apparatus was in operation before the gas had been completely turned on?

Ans. It would, and not one only, but several.

Cross-int. 58. Have you read and do you understand letters patent No. 230,590, granted to Jacob P. Tirrell, assignor to George F. Pinkham, and the invention therein claimed and described?

Ans. I have read it, and believe I understand it.

Cross-int. 59. Will you please examine the apparatus now shown you and state whether or not, in your opinion, it substantially embodies the invention set forth and claimed in said patent?

Ans. The apparatus now shown me appears to be a substantial embodiment of the apparatus shown and described in said patent. There are some changes in its disposition and arrangement, which, however, I do not regard as essential.

(Said apparatus has stamped on the brass shell thereof the words "Chas. S. Pinkham & Co., Philadelphia," and is now offered in evidence and marked on the tag attached thereto "Defendants' Exhibit No. 2, W. E. S., Ex'r, Nov. 4, 1885."

Adjourned.)

Nov. 5, 1885.

Cross-int. 60. If the two electrodes constituting the circuit-breaker of the apparatus, illustrated by Defendants' Exhibit No. 1, were soldered together would it be practicable without making any change in the apparatus to turn on the gas or to turn it off by means of the electric current?

Ans. It would not.

Cross-int. 61. In apparatus like Complainants' Exhibit Defendants' Burner, and which contains two armatures, one of the armatures is used, is it not, for the purpose of turning on the gas when magnetized and the other armature for the purpose of turning off the gas?

Ans. The statement in the question is undoubtedly correct,
32 but to it should be added, I think, that the armature which

turns on the gas also actuates the circuit-breaker so as to produce the spark.

Cross-int. 62. In the apparatus is the circuit-breaker attached to the armature?

Ans. It is not, but is so arranged as to be carried by the armature near the end of its stroke.

Cross-int. 63. That is to say, when the armature is attracted by the magnet the upper side of it, at a point near the burner, strikes against the lower end of the circuit-breaker, thus raising it a little and separating the movable electrode which forms the upper extremity of the circuit-breaker from the fixed electrode with which it remains in contact when the apparatus is at rest?

Ans. Yes; this is the action, as I understand it. Put in strict mechanical language, we have the armature acting as a lever of the third order upon the movable electrode, as stated in the question.

Cross-int. 64. Assuming this apparatus to be in perfect order and to be put in operation by an electric current of suitable power for the purpose of turning on and lighting the gas, would not the gas be completely turned on so that the rotation of the gas-cock would have ceased before an electric spark would be produced at the burner tip?

Ans. I do not think that would be the case as regards the cessation of the rotation referred to. As the apparatus is arranged the rotation must continue so long as the armature continues its upward motion when attracted by the magnet, the latter portion of which motion being effective in addition to the rotation of the cock in breaking the circuit.

Cross-int. 65. Through how many degrees of the circumference is the gas-cock rotated in this apparatus in the operation of turning on the gas and through how many degrees is it rotated before the armature in its upward movement comes in contact with the circuit-breaker? I understand, of course, that your answer must be merely an estimate in the absence of facilities for making accurate measurement.

Ans. I should judge the entire rotation to be about fifteen
33 degrees, and that contact with the circuit-breaker lasts during the rotation of two or three degrees at the close of the movement.

Cross-int. 66. In apparatus like said exhibit what is the mode of operation in turning off the gas?

Ans. The battery current is thrown through a second electro-magnet, similar to that employed in turning it on, so arranged as to actuate an armature lever similar to that employed in that operation, but so adjusted as to act on and turn the gas-valve in a direction opposite that in which it was turned in letting on the gas. This second armature, being a reduplication of the first, is not brought into contact with the circuit-breaker.

Cross-int. 67. If in this apparatus the movable and the fixed electrode at the burner tip was soldered together, would it be practicable to turn off the gas completely by means of the electric current, and without making any other change in the apparatus?

Ans. It undoubtedly would; but the apparatus then would be taken out of the category of electric gas-lighting apparatus.

Cross-int. 68. Assuming the electrodes to be soldered together, as stated in the last question, would not this apparatus be then capable of almost compfetely turning on the gas by employing the electric current?

Ans. It would.

Cross-int. 69. Please state what are the similarities and dissimilarities in the mode of operation between Complainants' Exhibit Defendants' Burner and Defendants' Exhibit No. 2.

Ans. In both we have a wire joined to an electro-magnet for turning on the gas by means of an armature, which armature can by its motion let on the gas, and break the circuit at the burner tip by means of a circuit-breaker, which in both is joined to the other end of the wire of the electro-magnet. In both I find electro-magnets employed for turning off the gas by means of armatures acting substantially as those employed to turn on the gas. In Defendants' Exhibit No. 2, the armature piece or lever, having a double function, is constituted of one piece of metal, having firmly connected therewith a slotted piece of metal, straddling a crank-pin in the gas-cock, so as to turn it in either direction, according as one or
34 other of the magnets is actuated by the electric current to turn the gas on or off. In the other the armatures are separated, and so arranged as both to act upwards upon nearly opposite points of the gas-valve, and thus turn it in either direction as may be required. The action of the armatures in both cases is substantially alike, so far as the circuit-breaker is concerned. The same is true of the general arrangement and action of the gas-cocks.

Cross-int. 70. Which apparatus would require the greater battery power for its operation, that like Defendants' Exhibit No. 1 or apparatus like Complainants' Exhibit Defendants' Burner?

Ans. That would depend upon the size and wire employed in winding the magnets in the respective cases; also upon the perfection of the details of construction. It would be easy, I think, to construct apparatus after either model, which would work equally well with the same battery. In the special apparatus referred to one could hardly say with precision whether the one or the other would require the greater power.

Direct examination resumed:

Int. 71. Referring to the several exhibits introduced by the defendants, state whether or not, in your judgment, they each contain a wire magnet, armature, and circuit-breaking pieces such as you have spoken of and referred to in the first claim of the original and fifth claim of the reissue Tirrell patents, Nos. 130,770 and 9743; and whether or not, in your judgment, they severally contain an embodiment of a substantial part of the invention described in said patents and referred to in said claims.

Ans. I have no doubt that the exhibits referred to in the question contain the parts mentioned in it, and that both present a substantial

embodiment of the invention referred to and set forth in the question.

Int. 72. Still referring to the same exhibits, state whether or not, in your judgment, they each contain substantially the automatically operated circuit-breaker of said last-named claims and the gas-letting-on mechanism in combination therewith, referred to in
35 claims 2 of said original and 4 of said reissue, and operate accordingly; and whether or not, in your judgment, said exhibits embody, as automatic electric gas-lighting burners, the invention described in said patents and referred to in said last-named claims.

Ans. I have no doubt that in both are found such circuit-breakers—such gas-lighting apparatus—and that both are substantial embodiments of the claims referred to, and that both are substantially described in both of said patents.

CYRUS F. BRACKETT.

Attest: WILLIAM E. SPEAR,
Special Examiner.

Nov. 5, 1885.

It is further stipulated and agreed between counsel that models working or otherwise of the inventions referred to in the preceding testimony may be introduced by complainants at any time during the taking of testimony, that the same may be ready with like effect as if introduced before the closing of complainants' *prima facie* case.

Attest: WILLIAM E. SPEAR, *Examiner.*

36 *Evidence for Defendants.*

Taken pursuant to the sixty-seventh rule of the Supreme Court of the United States, in equity, as amended, before me, George B. Haskell, special examiner.

Present: Edward P. Payson, Esq., of counsel for complainants; John E. Abbott, Esq., of counsel for defendants.

Boston, *Jan.* 26, 1886.

It is stipulated by and between the counsel for the respective parties that such portion of the testimony contained in the printed record of a certain suit in equity brought in the circuit court of the United States for the southern district of New York by the Electric Gas Lighting Company *v.* Luther G. Tillotson *et al.* as either party to the present suit may desire shall be printed as a part of the evidence in this suit, and that such testimony shall have the same force and effect and shall be subject to the same legal objections as though the witness whose testimony is thus reprinted had been duly sworn and examined as a witness in the present suit.

In accordance with the foregoing stipulation the counsel for defendants offers in evidence the printed record of the testimony of

Henry Morton given in said Tillotson suit and requests that the same be printed as a part of defendants' evidence in this suit.

Counsel for complainants admits that the exhibit referred to in said Morton's testimony as Complainants' Exhibit Pinkham Burner is like the exhibit in the present suit marked "Tirrell's 1880 Burner, Defendants' Exhibit No. 3, G. B. H., Sp'l Ex'r."

Deposition of Henry Morton.

HENRY MORTON, a witness produced on the part of defendants, being duly sworn, deposes as follows in reply to questions of E. N. DICKERSON, Jr. of counsel for defendants:

37 Int. 1. What is your name, age, residence, and occupation?

Ans. Henry Morton. I am forty-seven years of age, and am president of the Stevens Institute of Technology, at Hoboken, N. J., where I reside.

Int. 2. What opportunities have you had of rendering yourself familiar with the laws and facts of electric science and with practical operation of electrical instruments?

Ans. For more than twenty-five years I have constantly had in my use and possession a great variety of electrical apparatus, which I have used both in my original researches and in the instruction of students, as, for example, in the University of Pennsylvania, where I occupied the chair of chemistry before I accepted my present position.

I have also made numerous examinations and tests of new forms of electric apparatus, and have frequently constructed or caused such apparatus to be constructed under my supervision in the workshops of the Stevens Institute.

I have made the science of electricity a special subject of study during the last twenty-five years and have published many papers on the same, which have been printed in the scientific journals and reprinted and referred to in corresponding journals of this country and books in Europe.

Int. 3. Have you been called upon to give testimony as an expert in the United States courts in reference to patents involving questions of the operation of electrical instruments?

Ans. During the last ten years a large part of my time not occupied by my official duties has been taken up in connection with suits on electrical patents, in which I have been called upon to make examination of patents and apparatus and to give testimony in regard to the same.

Int. 4. Have you examined letters patent of the United States No. 9743, bearing date June 7, 1881, granted to J. P. Tirrell, for electrical apparatus for lighting street lamps, etc., and do you understand the same?

Ans. I have examined these letters patent No. 9743 and believe that I understand the same.

38 Int. 5. Please describe fully what you understand to be the invention set forth in the letters patent No. 9743, having in

mind the state of the art at that date and giving your reasons for any opinion you may express.

Ans. The invention set forth in this patent is, as I understand it, a combination of instrumentalities, all of them old, both in structure and operation, to produce a certain new effect—namely, the turning on and simultaneous lighting of a number of street gas-lamps in succession by means of a single circuit passing successively through a single magnet in each lamp, said magnet operating a break-piece, which, by reason of its automatic interruptions, both produces sparks to ignite the gas and also simultaneously opens the stop-cock so as to turn on the gas, and then, in conjunction with other mechanism, shuts off the current so as to arrest further movement when the gas is fully turned on and passes on the current to the next lamp of the series. This invention further involves an arrangement by which, by the use of another circuit, the gas can be turned off successively in the several lamps by the aid of the same magnet, break-piece, and the other instrumentalities which were employed to turn it on.

Operating a series of street gas-lamps in succession so as to turn the gas on and off by the use of one main conductor for such operation and employing only one magnet for both operations in each lamp was old, being fully set forth in patent No. 90629, June 1, 1869, granted to Edwin E. Bean, but in this case there was no automatic interrupter for producing sparks at the lamps, but the interruptions were produced at the lighting station.

In this Bean patent, however, the means employed for turning the gas on and off and shifting the circuits from lamp to lamp are substantially the same as in the patent No. 9743.

Patent No. 101,491, dated April 5, 1870, to Morris and Reid, shows the shutting off or turning on of the gas by the direct action of electro-magnets at the several burners and the shunting off of the current when it has done its work in each burner to the next in the series; but in this patent there is no automatic interrupter at the burner tip connected with either of the gas-controlling circuits, two of which are used with separate magnets—one for turning on
39 and the other for shutting off the gas. An automatic interrupter is used in this case for producing sparks to light the gas, but this is connected with a third electro-magnet, which is arranged in a third main circuit.

Again, patent No. 121,301, dated Nov. 28, 1871, granted to J. P. Tirrell, shows a single magnet with automatic break-piece actuating, by means of a pawl and ratchet wheel, the apparatus for turning the gas on or off and for shifting the circuit to the next lamp of the series, as in patent No. 9743.

In this case, however, the gas is igniter by a spark obtained from a helix, used as a primary induction coil, located at the burner, whose break-piece, however, is operated by the magnet which turns on the gas.

Again, in patent No. 121,302, dated Nov. 28, 1871, granted to J. P. Tirrell, the operations of turning on and turning off and shunting to the next lamp in series are accomplished by the use of two

and state whether you find therein the invention set forth in patent No. 9743, giving your reasons for any opinion you may express.

Ans. I have examined the Complainants' Exhibit Pinkham Burner and do not find it in the invention set forth and claimed in the patent No. 9743, for the following reasons:

This exhibit operates as follows: When a current is sent through one of the two electro-magnets which it contains the corresponding armature is thereby drawn towards it, and by this single movement the gas is at once turned onto the burner. After this movement is effected a further movement of the same armature causes an interruption of the circuit, and there is thus set up a rapid series of interruptions and consequent sparks brought about by a limited motion of the armature, which, by reason of the peculiar mode of connection between the armature and the gas-valve, has no influence whatever on the gas-valve.

This action will continue indefinitely without further result as long as an electric current is supplied to the same circuit.

The gas being turned on and lit in this manner, the circuit is broken by the operator; whereupon the armature remains close to the magnet, where it was drawn by the first impulse.

There is no shunting of the circuit or change of any sort in the connections.

When it is desired to turn off the gas a current is sent through another electro-magnet, which attracts another armature rigidly connected with the first, and this shuts off the gas by a single movement without the intervention of any interrupter or other mechanism.

No means is provided in this apparatus for shifting the current from one burner to another, nor can this apparatus be used in any such way as to effect the successive lighting and extinction of
43 a series of burners which is the principal object of the invention of patent No. 9743.

Comparing, in fact, the Exhibit Pinkham Burner with the invention shown in patent No. 9743, I find that that burner lacks the following conditions, which are essential features of the patented invention:

1st. It does not have any means of shifting the current from one burner to another, so as to allow a number to be lit on a single line from one station.

2d. It does not turn the gas on and off by the operation of an automatic interrupter.

3d. It does not turn the gas on and off by the action of the same magnet, but by different magnets.

4th. It does not light the gas by the same action that turns it on, but by a subsequent action, which does not involve any movement in the gas-turning mechanism, but, on the contrary, would render the whole apparatus inoperative if it did so.

5th. The action of the interrupter by which the gas is lit has, and must of course have, no influence on the mechanism for turning whereby the circuit changes, referred to as the novelty of the invention, are occasioned through appropriate switches. The vibration

rupter in the circuit. The combination of parts constituting the interrupter is only made operative after the gas is turned on, and ceases to exist as soon as the turning-off action begins.

Of the various instrumentalities mentioned in my last answer as involved in the invention of patent No. 9743, very few are present at all in the Pinkham device, and of these none but the wires carrying the current to the apparatus operate in the same way, and even these conducting wires carry the current in the patent to the same magnet, and in the exhibit burner to different magnets.

Thus the magnet F of the patent is represented in the Pinkham burner by two magnets, which open and close the gas-valve directly, and not through the instrumentality of a circuit-breaker and by repeated vibrations of the same.

The vibrating interrupter H of the patent is represented in the exhibit burner only by the interrupter at the burner tip, which is not connected with the armature of either magnet, nor is in
44 any way influenced by the motions which open or close the gas-valve, as is the interrupter of the patent, but is only acted upon by the armature of the turning-on magnet after that has completed its full function of turning on the gas.

The pawl S, the ratchet wheel R, the sector wheels *n* and *f*, the levers O and Q, and their connected parts for shifting the circuits are entirely unrepresented by anything in the Exhibit Pinkham Burner.

It is quite true that the patent and the exhibit both show "means of converting an electric current led into the apparatus by a conductor into mechanical energy, this means being an electro-magnet and its armature," but this is equally true of the various forms of apparatus described in the patents of E. F. Bean, No. 90628; of Morris and Reid, No. 101,491; of J. P. Tirrell, No. 121,301; and of J. P. Tirrell, No. 121,302, to which I have already referred, all prior to patent No. 9743.

It is not true, however, that the patent No. 9743 and the Exhibit Pinkham Burner "both also contain a means of breaking the circuit traversed by this current at the burner tip" in the sense that this current is the one by which the important "mechanical energy" used to operate the gas-valve is developed. In the Pinkham burner no means for breaking the circuit exists until the current has opened the gas-valve, and then only is this means of breaking the circuit then in use developed by reason of the previous movement and change in position of the armature.

It is true, in a way, that in the patent and exhibit "the movement of the circuit-breaker in both devices is produced by mechanism set in operation by the action of the current in the electro-magnet," but in exactly the same general sense is this true of the circuit-breaking devices of the Morris and Reid and the two Tirrell patents referred to above, and the differences are as great in the one comparison as in the other.

It is quite true of the Tirrell reissue device, as stated by Mr. Benjamin (fol. 72):

"That the fundamental idea is to cause one and the same current

of electricity to turn on the gas, and also to light it by a primary circuit."

45 And also that "the one current which enters the apparatus must operate the mechanism which aids in producing or produces both of the results above named. To that end part of that current must be converted from electrical energy into mechanical energy."

And also that the "energy of the current must undergo two forms of transformation in the invention under consideration, namely, into mechanical energy and into heat energy. The current must set in operation the mechanism, and by the motion of that mechanism, beside turning on the gas, also establish conditions for itself, whereby itself—that is, the current, not the mechanism—shall communicate enough heat by the production of a primary spark to the gas to inflame that gas."

By looking at the device of the Tirrell reissue it will be seen that when the armature H is drawn to the magnet it performs two acts which are simultaneous. It breaks the circuit between points *a* and *b* and rotates the ratchet wheel R. The same current of electricity—that is, the same energy—accomplishes these two results, and is transformed simultaneously into two forms of energy, namely, mechanical and heat energy. This is an essential condition of the operation of the Tirrell device, and I agree with Mr. Benjamin that it is one of the essential and necessary elements of any apparatus, equivalent to that apparatus. Further, the apparatus is so constructed that these two operations necessarily occur simultaneously and by the same motion. If the spark-breaking points be tied together the gas cannot be turned on; neither can the gas be turned on without simultaneously making a spark at the burner tip. With the explanation given by Mr. Benjamin himself of this essential point of novelty in the Tirrell apparatus I fail to see how he can find any infringement in the Pinkham device.

In the Pinkham device the exact opposite of this state of affairs is true. In that device one current of electricity is used to turn on the gas and another succeeding current is used to light it.

Supposing the gas to be turned off, the first operation, when a current is sent through the gas-opening magnet in that device, is to shift the gas-cock and open it wide.

46 The Pinkham device may be readily operated by touching the current-controlling key sufficiently long to transmit a current to turn on the gas without lighting it. There is no operation of any circuit-breaker or of any gas-lighting device during this operation of turning on the gas.

When that operation has been completed another current of electricity, which may be a succeeding current from the same battery or a current from another battery, if desired, is called into play. This next current performs no function in turning on the gas whatever, that function having been completed; but this current sets in operation an automatic circuit-breaker at the burner tip, which lights the gas without doing the mechanical work of turning on the gas at all, that work having been previously completed.

Looking more specifically at the Pinkham apparatus, the circuit-breaking points may be tied together and the apparatus operated to turn on the gas fully, or, the gas having been turned on fully without being lighted, the apparatus may be put into operation to light it without turning it on. There is no transformation of the same current into mechanical energy used in turning on the gas and heat energy used in lighting it.

To resume, therefore, the essential principle of operation of the Tirrell and Pinkham devices is entirely different. In one the same current performs two functions simultaneously, and is divided, as Mr. Benjamin expresses it, into two forms of energy, one form being used to turn on the gas and the other form simultaneously to light it. In the Pinkham device successive currents and different parts of the apparatus successively brought into operation are used to perform these two operations.

It seems that Mr. Benjamin in substance agrees with me in this opinion, for he says:

"Cross-int. 134. And I understand it is your opinion that the claims of the patent are to be limited to apparatus in which one current of electricity is used to perform the two operations of turning on the gas and lighting it. That is your understanding, is it not?

"Ans. Yes, sir."

"Cross-int. 148. Please assume Exhibit Pinkham Burner attached to the chandelier in this room, which is provided with a gas-cock, and that the burner is likewise provided with suitable elec-
47 trical connections. Please assume that the gas-cock in the chandelier is turned off and a current of electricity is sent through the burner, thereby opening the gas-cock in the burner. Please assume that the gas-cock in the chandelier is turned on and a subsequent electric current is sent through the burner, thereby lighting the gas. Could such an apparatus be so operated?

"Ans. Yes, sir.

"Cross-int. 149. Would these two currents be, in your opinion, the same current of electricity within the meaning of the patent?

"Ans. Under this explanation I should regard the two currents as different currents."

"Int. 152. Please assume that Exhibit Pinkham Burner were attached to a gas-pipe without a gas-cock for the purposes of this question. Please assume that the electrically controlled valve was shut. Now please assume that an operator touched the battery-controlling key, making a single impulse sufficient to open the gas-valve, but not sufficient in duration to light the gas. Please assume that he then subsequently again closed the key, sending another electrical impulse upon the wire, which would then operate the circuit-breaker without turning the gas-valve, the supposition being identical with that of the last question, excepting that the gas-cock in the pipe has been omitted, and the same result is obtained from the manipulation of the burner as was formerly obtained by the manipulation of the gas-cock, would you then say that these two

subsequent and independent impulses were the same current of electricity?

"Ans. I should say they were different currents for about the same reasons given in my last answer."

It is true that Mr. Benjamin points out in this connection, as I understand, that if these two successive currents causing these two successive operations of different portions of the apparatus succeeded each other so rapidly that the interval of time elapsing was not readily perceived they would be, in his estimation, one and the same current; but this, I think, is manifestly an opinion which could not be accepted by any one looking at the matter without prejudice.

48 In either case in the Pinkham device the operations of turning on the gas and of lighting it are distinct and successive, and, mechanically and electrically considered, when that apparatus is operated, as it is to be operated, by turning on the gas and lighting it by the action of the electric current alone its operation is the same as the operation pointed out in the 152d cross-question above quoted—that is, the interval of time between the operations of turning on the gas and of lighting it assumed in the question does not and cannot make any difference in regard to the question as to whether the electricity during the two operations is the same current or different currents. In considering the electrical operations of this kind the question of the perceptibility of the interval of time does not practically come in at all, because the operations of electricity are, as a rule, so rapid as to be almost imperceptible by the senses.

Looking at the patent No. 9743, the essential novelty of the device and the invention is stated to exist in an apparatus by which successive gas-burners can be lighted through the same wire by the use of a battery capable of lighting only one of those burners. This invention does not and could not exist in the Pinkham device. If successive burners were to be lighted by that device a battery of sufficient strength to light them all simultaneously would have to be employed if one burner were used, or else a different wire would have to be used connecting each burner with the battery. In carrying out his invention practically Tirrell uses one magnet, one armature, a pawl connected therewith, a ratchet wheel controlling a gas-cock, and two circuit-breaking cams and a circuit-breaker, which apparatus, by one and the same movement, turns on the gas and simultaneously lights it and afterwards turns it off by the same operation of the same magnet. All the above elements are essential to the operation of this device. No one of them could be omitted from it without leaving the apparatus inoperative for performing the functions which it is described as performing in the patent.

As Mr. Benjamin states the combinations included in the second and fifth claim in his twenty-ninth and thirty-first cross-answers, they consist of the parts E, T, J, K, G, H, R, S, and a gas-cock. I should add to these and as essential elements of these combinations to make them operative the levers Q and O and cams *f* and *n*

49 and their necessary connections, for otherwise the apparatus

is inoperative to perform the results in which the invention is stated to consist.

Turning now to the Pinkham device, this apparatus contains two magnets and two circuits within itself to do the work of turning on and off the gas instead of one magnet and one circuit, as in the Tirrell device. It contains no pawl and ratchet wheel or any equivalent therefor. It contains no cams *f* and *n* and no levers Q and O. Its gas-cock is entirely different in construction from the gas-cock shown in the Tirrell apparatus.

Instead of containing the eight elements which Mr. Benjamin states to be the elements of the combinations of the second and fifth claims, or the twelve elements which I believe to be necessarily included in those claims to make them operative, it contains but five or six elements in no way corresponding to those of the Tirrell claims, and even these are operated in a different manner, as previously explained, and likewise differ in their construction.

I am clearly of the opinion, therefore, that the Pinkham device does not contain the invention described in the Tirrell reissue and claimed in the claims thereof.

Int. 7. Please look at Defendants' Exhibit Tirrell Original Patent, and compare the invention of the first claim with the inventions of the second and fifth claims of the Tirrell reissue, if construed to cover defendants' apparatus.

Ans. The first claim of that patent is in the following words: "A circuit-breaker located at the burner and operated automatically, substantially as described."

In my opinion that claim to have been valid must have been construed to refer to the automatic operation of lighting burners in succession—that is, that the circuit-breaker at the burner should operate automatically to perform the two functions of turning on the gas and lighting it and then shunting the current to the next burner; otherwise it would have included any automatic circuit-breaker located at the burner, which I have shown to have been old. The second and third claims of this original patent would not include the defendants' apparatus in this suit. I am therefore of opinion that if the second and fifth claims of the Tirrell reissue should be construed so broadly as to include defendants' apparatus they would be broader in their scope than the claims of the original patent properly construed.

Int. 8. Referring to the stop-cock shown in Fig. 4 of the drawing and the description thereof in the specification, will you please state whether, if an apparatus were constructed in accordance with that specification and drawing, in your opinion it would be operative to perform the usual functions specified in the patent as appertaining to it?

(Objected to as not warranted by the pleadings.)

Ans. If constructed in literal accordance with the drawing it would not be operative. The reason is that the position of the cams shown in Fig. 1 correspond with a position of the stop-cock in which the gas is shut off, whereas the position of the stop-cock shown in Fig. 4

would be one in which the gas was fully on, and would continue on until nearly half a revolution of the cock, when the gas would be shut off. In other words, when the cam reached such a position that the current was again shifted so that the next passage of a current would be that for turning off the gas the gas would be already turned off, and the attempt which had been made to light it would have been a failure; also the apparatus while in the position shown would be such as to allow a full flow and escape of the gas.

Int. 9. Please look at the Defendants' Illustrative Exhibits 1, 2, 3, 4, 5, and 6 and state whether, in your opinion, those exhibits and their method of operation could be easily understood by any one acquainted with the art to which the Tirrell patent refers.

Ans. They unquestionably could, being, in fact, very much simpler than the drawings and descriptions of this patent.

Int. 10. Have you examined the letters patent No. 220,704, dated Oct. 21, 1879, granted to William C. Cutler, and do you understand the same?

Ans. I have examined these letters patent, and believe that I understand them.

Int. 11. Please state what you understand to be the invention set forth in the patent above referred to.

Ans. The invention set forth in this patent involves the
51 turning on and lighting of a single gas-burner by electricity, and this result is effected in the following manner: Two magnets are secured to the base of the burner, operated by separate circuits. Over these magnets are supported the armatures carried by a rocking bar rigidly connected with the gas-valve, so that when one armature is drawn down the valve is open and when the other is drawn down it is shut. Attached to this same rocking bar is a vertical rod carrying an elastic contact piece, which makes and breaks circuit at the burner tip once as it is carried across with the movement of the rocking bar in turning on the gas. From the lower side of the same rocking bar projects another contact piece, which also makes contact when the rocking bar is in position for shutting off the gas, and maintains this contact until the gas-valve is nearly full on, when it breaks the contact once for all, as far as it is concerned, until the gas is turned off again by the action of the other magnet.

The action is then as follows: The gas being shut off, to begin with, a current enters the magnet and passes out through this lower contact. The corresponding armature, being attracted, draws down the rocking bar on that side, which, by reason of its rigid connection therewith, opens the gas-valve. Before this motion, however, is finished the contact piece at the burner is caused to make and break contact, so completing the motion in this direction and igniting the gas.

This contact piece is in no respect a vibrating interrupter in the usual sense, as it causes no vibrations nor in any way affects the motion of the magnet armature by its interruption of the current.

The instrumentalities involved in this invention of the Cutler patent are—

1st. Two circuits and two magnets connected therewith.

2d. A rocking bar carrying two armatures at its opposite ends, acted upon by the two magnets, and rigidly connected with the gas valve.

3d. A contact piece connected with the said rocking bar and making a spark by breaking a momentary contact at the burner tip by a "wiping" movement.

4th. A second contact piece closing the turning-on circuit
52 as soon as the gas is shut off. This, though not mentioned in claim 1, is essential to make the apparatus operative.

Int. 12. Please compare Complainants' Exhibit Pinkham Burner with the invention of the above-mentioned Cutler patent and say if you find it to contain such invention, giving your reasons for any opinion you may express.

Ans. I have made the comparison your question calls for and do not find that the Pinkham burner contains the invention of the Cutler patent.

The invention of the Cutler patent is very clearly defined and limited in its specifications and claims to the combination of instrumentalities stated in my last answer, and I find none of these in the Pinkham burner except the first, namely, two electro-magnets with two circuits to actuate them, and this is an old combination found in several of the older patents already referred to, such as that of Morris and Reid or the Tirrell patent No. 121,302.

The rocking bar, rigidly connected with the gas-valve, is not found in the Pinkham exhibit, and if introduced would render it practically useless.

The contact piece connected directly with the armature by means of the rocking bar is also wanting in the Pinkham exhibit and would be inoperative if introduced therein.

The second or lower contact piece is also absent in the Pinkham exhibit and would perform no function in that apparatus if introduced.

The insulated fixed point *j* and elastic or yielding point constituting the contact piece, producing sparks at the burner, are specifically disclaimed in the Cutler patent, as indeed are all the constituent parts of the apparatus, the claim of this inventor being emphatically limited to the specific combinations and arrangements shown.

Int. 13. If the first claim of the Cutler patent was construed so broadly as to include two magnets, a rocking lever, arranged to actuate the gas-cock, and a circuit-breaker, operated by such rocking lever, independent of the exact devices and circuits shown in the Cutler patent, will you please state whether you would find such combination in any prior patent?

Ans. I would find such combination in letters patent
53 granted to Tirrell on the 28th day of November, 1871, No. 121,302. In this patent will be found two electro-magnets the exact equivalents of the electro-magnets *e f* of the Cutler device, a pair of armatures connected to a rocking lever, which rocking

lever operates a gas-valve, and which is the exact equivalent of the Cutler rocking lever, and a circuit-breaker operated by said rocking lever. The mechanical construction of this device is more similar to the Exhibit Pinkham Burner than the Cutler device is—that is to say, the circuit-breaker is a vertical reciprocating circuit-breaker which moves up and down in a right line, as does the rod operating the circuit-breaker in the Pinkham device. This circuit breaker is not rigidly attached to the vibrating lever, but is so connected as to be operated thereby at intervals, while in the Cutler device the circuit-breaker is upon a radial arm rigidly attached to and swung by the rocking lever. The circuits in the Tirrell device are not the same as the circuits in the Cutler device any more than the circuits in the Pinkham device. In my opinion, therefore, even if Cutler had not arbitrarily limited himself in his patent to his specific devices and constructions, the first claim of his patent must necessarily have been construed for such specific devices, or it would have been anticipated by the prior state of the art.

Int. 14. Have you read and do you understand letters patent No. 230,590, dated July 27, 1880, to J. P. Tirrell, assignor to Geo. F. Pinkham? And, if so, please state what you understand to be the invention therein set forth.

(Objected to as immaterial and irrelevant.)

Ans. I have read and believe that I understand the patent referred to, and find the invention which it discloses to consist of several elements, some of which are old and some new.

In the first place, it involves the use of two magnets with connected circuits actuating an armature in opposite directions so as to open and close a gas-valve at the burner. This combination is old, because manifestly there is no difference between the action of two magnets alternately on one armature swinging between them and the action of two magnets on two armatures rigidly connected and rocking over the magnets, as in the Morris and Reid patent
54 of April 5, 1870, or the Tirrell patent of November 28th, 1871, No. 121,302, already cited. In the present case, however, the armature is not directly connected with the gas-valve, but only operates on it through a fork straddling a pin in such a manner as to allow a considerable movement of the armature to be made without any effect upon the gas-valve. This combination is new at the date of this patent and confers new and beneficial capacities on the combination. For example, it allows the armature to acquire a certain momentum before it is required to move the gas-valve, and thus insures its successful operation at all times. This same new feature also allows the armature to make minute and repeated vibrations sufficient to actuate an interrupter and produce a spark without its effecting at the same time the flow of the gas.

The element next in importance in the combination shown in patent No. 230,590 is the contact piece for producing sparks at the burner tip. As such it is not new, being found in the early patents of Tirrell just referred to, No. 121,301 and 121,302, but in the present patent it is new in its combination with the armature, be-

cause in the present case it is not in constant contact with the armature, and therefore affected by all its motions, but only comes into contact with the armature and co-operates therewith when the latter reaches nearly the end of its motion in the direction of turning on the gas.

By reason of this arrangement many advantages are secured and the mode of operation is radically changed.

Thus during nearly all its operations the armature has no connection with this break-piece, and therefore performs its functions freely and not as part of an automatic interpreter, but as an attracted armature moving simply and positively in one direction or the other. It is thus enabled to perform its functions of opening or closing the gas-valve in a simple and direct manner, which would be impossible with any armature which was constantly attached to and co-operating with or forming in fact part of an automatic interrupter.

Briefly stated, the novel features of patent No. 230,590 are—

1st. The combination of the armature N with the gas-cock by means of the fork *g* and pin *f* in the manner described.

2d. The combination of the armature N with the movable electrode e^1 by means of the curved arm, hook, yoke, or link *h*, as shown and described.

By reason of these novel features this apparatus is rendered not only much simpler in construction and more certain in operation than any of those previously in use, but it also performs its various essential functions in radically new ways as compared with either of the patents involved in this suit.

Int. 15. Will you please state how Exhibit Pinkham Burner compares with the Tirrell patent No. 230,590?

Ans. It is substantially identical, both in structure and in operation, with the burner described in the Tirrell patent.

NEW YORK, *May* 5, 1884.

Met pursuant to notice.

Present: Same parties.

Continuation of direct examination of Dr. MORTON:

Int. 16. Please look at Defendants' Exhibit Morris and Reid Patent, in which two circuits are shown—one for turning on the gas and one for lighting it—and state how much change would be necessary, in your opinion, in an apparatus of that description in order to substitute one circuit for two, and how much invention, if any, such substitution would require.

In giving any opinion on this subject you may refer to the state of the art relating to similar contrivances.

(Objected to as immaterial and irrelevant, and, further, to the giving of any secondary evidence as to the state of the art.)

Ans. I think a very slight change only would be necessary to secure the difference in arrangement of circuit mentioned in your question. In other words, if the connecting wires were so changed

that the current, after passing through magnet B, passed through magnet C, and if at the same time the locking device were omitted, the apparatus would operate both the turning on and lighting by the same circuit. Such a substitution of a single circuit for two circuits in doing the same thing was and is common in the art pertaining to such matters, as in the case of various printing tele-
56 graphs, in some of which two, and in others one, circuits accomplish the same result.

Cross-examination by Mr. BROWN:

Cross-int. 17. Is the device of letters patent No. 9743, which you have referred to as a break-piece, the same device which is referred to in the patent as a circuit breaker?

Ans. It is, where referred to in connection with that patent.

Cross-int. 18. Do any of the patents which are in evidence and which are prior in date to the Tirrell patent, No. 130,770, of Aug. 20, 1872, show an electro-magnet in circuit with the circuit-breaker and so combined that one current of electricity will energize the electro-magnet so as to cause it to operate the gas-cock and vibrate the circuit-breaker, and so as also to produce a spark, lighting the gas between the parts of the circuit-breaker when they are separated?

Ans. There is none which contains this exact combination.

Cross-int. 19. In each the electro-magnet for operating the gas-cock and vibrating the movable part of the circuit-breaker is in one circuit, and there is another circuit containing a circuit-breaker, through which the electric current passes, for producing the sparks; is not that so?

Ans. That is true.

Cross-int 20. In your 5th answer you say, "It is obvious that this operation would continue indefinite, and the gas would be turned off and on successively in operation, were it not for the circuit-breaking cams," and in making the statement you assumed, did you not, that the circuit would be left permanently closed by the operator?

Ans. That is true in reference to the passage quoted.

Cross-int. 21. If the circuit containing a burner like Exhibit Pinkham Burner were left permanently closed by the operator would not the circuit-breaker continue to operate indefinitely until the battery were run down?

Ans. It would.

Cross-int. 22. Have you made any experiments with an apparatus like that shown in patent No. 9743 for the purpose of de-
57 termining whether, if the switching mechanism were omitted and the leading-in wire of the battery were connected directly with one end of the helix of the electro-magnet, the gas-cock could be rotated so as to turn the gas full on and the electro-current could then be stopped by breaking the circuit so as to leave the gas turned on and ignited?

Ans. I have.

Cross-int. 23. Where did you get the apparatus, and where is it?

Ans. The apparatus was given to me by Mr. Bogart, and is now in my office at Stevens Institute of Technology.

Cross-int. 24. Was it exactly like the apparatus shown in the patent No. 9743?

Ans. Not in all its details, but it was substantially like this apparatus as to the parts involved in this experiment.

(Counsel for defendants states that the cross-examination of this witness as to experiments with this apparatus does not relate to any subject-matter inquired about in the direct, and the complainant's counsel is informed that he is making the witness his own in this line of examination.

Counsel for complainant submits that the entire cross-examination is proper.)

Cross-int. 25. Could not an apparatus like that shown in patent No. 9743 be operated as suggested in 22d question?

Ans. Not practically, but only with occasional failure, unless the operator had the burner clearly in view, used a carefully adjusted current, and had obtained considerable experience, and I might even say sleight of hand, in conducting the experiments; otherwise he would frequently only get the burner turned partially on or more than full, which would be, of course, partially off or in such a condition that the gas would leak without being lit.

Cross-int. 26. In Exhibit Pinkham Burner is not the magnet by which the gas-valve is operated and by which the movable part of the circuit-breaker is vibrated in the same circuit with the circuit-breaker?

Ans. The magnet by which the gas-valve is at one time
58 operated and by which the circuit-breaker is subsequently vibrated is in the same circuit with the electrodes of said circuit-breaker, but during the time that this magnet is operating the gas-valve there is no circuit-breaker in connection with it, this connection being established only after the operation of turning on the gas is complete.

Cross-int. 27. Do you mean that the electrodes of the circuit-breaker are not always in Exhibit Pinkham Burner in the same circuit as the helix of the electro-magnet, whereby the gas-valve is shifted to turn on the gas and the movable part of the circuit-breaker vibrated?

Ans. I mean that in this apparatus there are what I have called electrodes, one being movable and the other fixed, which do not form a circuit-breaker until the gas has been fully turned on in the operation of this machine. Then, and only then, by the movement of the armature when it comes in contact with the end of the movable electrode is a combination formed constituting a circuit-breaker. It is, therefore, true that these electrodes are always in the same circuit with the magnet, but they only come to constitute part of a circuit-breaker after the gas has been turned full on, and at all other times are not parts of a circuit-breaker, which, in fact, is not found in this instrument at any other time except at the time I have mentioned, namely, when the gas has been turned full on by the movement of

the armature in such a direction as brings it in contact with the lower end of the movable electrode.

Cross-int. 28. In Exhibit Pinkham Burner there is one electro-magnet which operates the gas-cock for turning on the gas and which also effects the vibration of the movable part or electrode of the circuit-breaker, is there not?

Ans. There is.

Cross-int. 29. Do you know anything about the manner in which burners like Exhibit Pinkham Burner have been used in practice?

Ans. I do.

Cross-int. 30. Has the circuit been kept closed until the gas was turned on and ignited, so far as your experience goes, in the use of such a burner?

59 (Objected to if the testimony of this witness is to be used to make up an insufficiently proved case of infringement, unless it be shown that this witness has knowledge of the use to which the said apparatus, Exhibit Pinkham Burner, had been put by the defendants herein and the method of its operation.)

Ans. As far as I know, the circuit is kept continuously closed until the gas is both turned on and lit.

Cross-int. 31. In your opinion could an operator practically turn on the current by closing the circuit in which such a burner was used just long enough to cause the electro-magnet by which the gas-cock is opened to merely open the gas-valve without at all operating the movable part or electrode of the circuit-breaker?

Ans. He undoubtedly could if the apparatus were adjusted so as to facilitate such an operation.

Cross-int. 32. Could he do this, in your opinion, without a chance of occasional failure to stop the current at the precise point mentioned in my last question?

Ans. I think the apparatus might be so adjusted as to leave very little, if any, chance of failure in this respect.

Cross-int. 33. Would it not be necessary to use a carefully adjusted current?

Ans. Yes; it would be necessary to use a current not too strong.

Cross-int. 34. Would it not be necessary for the operator to acquire considerable sleight of hand?

Ans. I think not. It would be merely necessary for him to make a single quick movement closing and breaking the contact.

Cross-int. 35. If an apparatus like that shown in the patent 9743 had one of the battery wires connected directly to the helix of the electro-magnet and the operator made a series of quick movements of the key could he not cause the electro-magnet to rotate the gas-cock step by step and in that way practically leave the gas turned on and ignited just as he might desire?

Ans. While I can't say that such a result would be unattainable, it would be undoubtedly extremely difficult to secure it, and it could only be secured, as far as I can imagine, by wonderful skill and considerable practice, because the thing necessary in this case would

be a very exact timing of the duration of contact, time after
60 time, so that the turning on and turning off should each be effected with precise regularity. While such a result might be within the limits of human skill, I should regard it as quite a triumph in that direction if accomplished.

Cross-int. 36. In a burner like Exhibit Pinkham Burner if a piece of insulating material were placed between the electrodes of the circuit-breaker or the electrodes of the circuit-breaker were kept widely separated, could the electro-magnet by which the gas-cock is shifted to let on the gas be energized to operate the gas-cock?

Ans. It could not.

Cross-int. 37. In an apparatus like that shown in the patent 9743 would not a portion of the electric current be consumed in energizing the electro-magnet for the purpose of operating the gas-cock for letting on the gas, and consequently would not another portion of the current be necessary to produce a spark at the electrodes of the circuit-breaker for igniting the gas?

(Objected to unless the counsel will state what he means by "consumed," and also what he means by "a portion.")

Ans. Not as I understand the action of an electric current in general or the action of this particular apparatus considered as a piece of mechanism. The same current at any instant is involved in all parts of the circuit through which it is flowing, and, though it may do some work in one point and some other work in another point, these involve no separation whatever in the current doing them, any more than there would be a separation in the force or motion involved in a line of shafting which operated pulleys at different points along its length. As a mechanical combination, I understand that the Tirrell burner referred to has its gas-turning mechanism operated by the interrupting action of the interrupter, and it is the electric action of the interrupter which, by mechanical means, effects the turning on of the gas. The current, as a whole, sets in motion a lever, which lever, by one and the same motion, effects the formation of the spark and the movement of the gas-cock.

(Adjourned to May 6, 1884.)

61 NEW YORK, *May* 6, 1884.

Continuation of cross-examination of Dr. MORTON by Mr. BROWN:

Cross-int. 38. In your sixth answer, at page 11 of the Printed Record, you say of the Pinkham device: "In that device one current of electricity is used to turn on the gas, and another succeeding current is used to light it." In what sense do you use the terms "one current" and "succeeding current" in that statement?

Ans. In the sense that I should consider that when an electric current passing through an apparatus had performed a certain function that current was complete in itself and could be properly considered as a definite thing, and that if, after the battery which supplied this current had completed this action, it continued further to

supply more current, by which a further and different function was performed in the apparatus, these two currents would be properly distinct and distinguishable from each other, because both of their succession in time and of their difference in function or operation. Their succession in time alone would not perhaps always constitute them different currents, because we might have an operation which required the continuous action of a current, and then we would consider all the electric energy known as current required to perform that action as constituting one current, even though the time required for the completion of the action were considerable; but when we have both a succession as to time and a difference as to function I should consider that the separation or the division into different currents was clearly marked and supported.

Cross-int. 39. Assuming that a circuit containing a burner like Exhibit Pinkham Burner were kept closed for a sufficiently long time to energize the electro-magnet by which the gas-cock is operated, so that such gas-cock would be opened to allow the escape of gas, and so that the movable part of the circuit-breaker would be operated without any interruption of the circuit by the operator, you would then, as I understand you, consider that two currents were employed to do the work of opening the gas-cock and operating the movable part of the circuit-breaker?

Ans. I should.

62 Cross-int. 40. And it is in that sense that you have spoken in your testimony of two currents being employed in operating a burner like Exhibit Pinkham Burner, as I understand you?

Ans. It is.

Cross-int. 41. And each of the two currents, as you have called them, passes through the electro-magnet for opening the gas-cock and through the circuit-breaker while doing its work, does it not?

Ans. Each of them passes through the magnet—the first of them continuously, and the second of them interruptedly or in pulsations. The second of them passes through a circuit-breaker properly so called, but the first of them only passes between two electrodes, one of which is fixed and the other of which is movable, but which is not provided with any means for giving it motion until the gas has been turned on.

Cross-int. 42. Each of the so-called currents passes through the electro-magnet for opening the gas-cock, and through the parts of which the circuit-breaker is formed, does it not?

Ans. It does, although here also there is the distinction that the first current passes continuously and the second interruptedly through both of the parts mentioned; in other words, while the first current is passing the circuit-breaker is inoperative and might just as well be absent.

Cross-int. 43. When you say that the circuit-breaking points of the Pinkham apparatus may be tied together and the apparatus operated to turn on the gas, you do not mean to intimate that there is any advantage in doing this, as I understand you, but merely state this to illustrate the action of the parts. Is that so?

Ans. I merely state this to illustrate the difference in the action between these parts and the circuit-breaker of the Tirrell patent.

Cross-int. 44. When you say, on page 12 of Defendants' Record, "that there is no transformation of the same current in the mechanical energy used in turning on the gas and heat energy used in lighting it," you use the term "same current" in the same sense in which you use the term "current" in answering questions 39 and 40?

Ans. I do.

63 Cross-int. 45. Is Exhibit Pinkham Burner like the drawings of the Tirrell patent No. 230,590?

Ans. It is substantially like, but there are certain differences in detail.

Direct examination by Mr. DICKERSON, Jr.:

Int. 46. You have been asked certain questions as to whether the same current in Exhibit Pinkham Burner passed through the circuit-breaking points and through the magnet controlling the gas-valves. Will you please point out whether it is true in the same sense of the Pinkham burner as it is of the burner shown in the Tirrell patent, that the same current passes through the magnet which operates the gas-valve during the time that it is operated both in opening and closing the gas?

Ans. The conditions, as I understand them, are very different in these two devices. In the Tirrell device it is the very same current in every sense, which always, both in opening and closing the gas-valve, also at the same time passes through the circuit-breaker. This is always and in all parts of operation an interrupted current. On the other hand, in the Pinkham burner it is only during the turning on of the gas that the current passes at the same time through the magnet and the connecting parts of the circuit-breaker. During the turning off the current passes through another magnet and does not pass through any part of the circuit-breaker at all, and in both the turning on and the turning off the current which accomplishes the action is a continuous current and not an interrupted one.

HENRY MORTON.

Deposition of Jacob P. Tirrell.

Direct examination by JOHN E. ABBOTT, Esq., of counsel for defendants:

BOSTON, *Jan.* 26, 1886.

Int. 1. Please state your name, age, residence, and occupation.

Ans. Jacob P. Tirrell; age, fifty-one years last March; residence, Chelsea, Mass.; occupation, machinist, model-maker, electrician, and inventor.

Int. 2. Have you ever had any experience in the construction or operation of electric gas-lighting apparatus?

64 Ans. I have.

Int. 3. When did you first have anything to do in regard to such apparatus and what did you do?

Ans. In the year 1869 I was employed by Mr. Edwin E. Bean to make a model of electric gas-lighting apparatus of his invention. My attention has just been called to the printed copy of the specification and drawings of letters patent of the United States No. 90629, granted to said Bean, and dated June 1, 1869, and I recognize the drawing as representing the apparatus I made for Mr. Bean.

Int. 4. Did you do anything further for Mr. Bean or under his direction in regard to electric gas-lighting apparatus?

Ans. Some time after that—I think about March, 1870, but I am not sure as to the date—I assisted in building with Frank Bean some fifteen electric gas-lighting burners, which were applied to street lamps on Park and Beacon streets, Boston, by the side of the Common. This apparatus was similar in construction to that shown in patent No. 90629.

Int. 5. Did that apparatus operate successfully?

Ans. It did not.

Int. 6. Are you the Jacob P. Tirrell to whom letters patent of the United States were granted which are numbered and dated as follows: Nos. 121,301 and 121,302, each dated Nov. 28, 1871; No. 130,770, dated Aug. 30, 1872; No. 184,807, dated Nov. 28, 1876, and Nos. 230,589 and 230,590, each dated July 27, 1880, all of said patents being for automatic electric gas-lighting apparatus?

Ans. I am.

Int. 7. About how much of your time since 1868 has been occupied either in constructing, applying, operating, or inventing electric gas-lighting apparatus?

Ans. About one-third of the time.

Int. 8. What were the first patents which were obtained by you for such apparatus?

Ans. In 1871, Nov. 28, Nos. 121,301 and 121,302.

Int. 9. Please examine the apparatus now shown you and state if you know what it is and how you are able to recognize it. (The apparatus has a tag attached to it, marked "Tirrell's 1872 Burner, W. E. S., examiner, Nov. 4, 1885, Defendants' Exhibit No. 1.")

65 Ans. I identify it as one of a lot of seventy-five built at shop 101 Merrimac street, Boston, about 1873 or 1874. It was made under my supervision.

Int. 10. Does that burner embody any patented invention; if so, what?

Ans. It is the principle of my 1872 patent.

Int. 11. Do you know whether any burners like that in their construction were put into practical operation; if so, for what purpose were they used and with what result?

Ans. They were put into the streets of Chelsea, a few of them, for street-lighting. It was an experiment. The apparatus did not give satisfactory results.

Int. 12. Was not your first invention made with the design of

remedying defects in the operation of Mr. Bean's apparatus, which had been tested on Boston Common, as you have testified?

Ans. It was.

Int. 13. In the automatic lighting of street lamps by electricity is or is not switching mechanism essential in any practical apparatus?

Ans. It is so, in my judgment. I consider it absolutely necessary.

Int. 14. Has it not been your object, in each successive invention you have made relating to electric gas-lighting apparatus, to simplify the apparatus of earlier inventions and to remedy their defects as developed by tests?

Ans. Yes; my main object was to simplify them.

Int. 15. To the best of your knowledge, to what extent were burners like Defendants' Exhibit No. 1 ever used?

Ans. They were used for street-burners. They were not used after the experiment at Chelsea for that purpose, or for any other, so far as I know.

Int. 16. Were they used anywhere else, to your knowledge, than in the Chelsea experiment?

Ans. Not that I know of.

Int. 17. So far as you know, when was automatic electric gas-lighting apparatus first used for house-lighting or for in-door lighting?

66 Ans. I think in 1874 or 1875.

Int. 18. What kind of apparatus was that?

Ans. It was after the pattern and construction of the patent numbered 184,807, dated Nov. 28, 1876.

Int. 19. To what extent was that apparatus used?

Ans. I only know of three instances, two in Chelsea and one in Boston.

Int. 20. When first, so far as you know, did there begin to be any considerable use of automatic electric gas-lighting apparatus for house-lighting?

Ans. About 1878 or 1879.

Int. 21. State, if you can, what such apparatus was like in its construction?

Ans. It was like the construction shown in the drawing of patent No. 220,704, granted to W. C. Cutler and dated Oct. 21, 1879.

Int. 22. Please state, if you know, whether apparatus constructed in accordance with patent No. 230,590, dated July 27, 1880, has been put into practical use to any considerable extent.

Ans. Of my personal knowledge I know of from fifteen to twenty, which I made myself, and which were put into use, and which were substantially like the burner I now produce, and which is marked "Tirrell's 1880 Burner, Defendants' Exhibit No. 3, G. B. H., Sp'l Ex'r."

Int. 23. Did burners constructed in substantial conformity with said patent No. 230,590 operate successfully in practical use?

Ans. They did.

Cross-examination by EDWARD P. PAYSON, Esq., of counsel for complainants:

Cross-int. 24. Were either of your inventions set forth in the letters patent 121,301 and 121,302 ever put into practical operation and used for any length of time by Mr. Bean for outside lighting?

Ans. They were never used at all by Mr. Bean, but I think there were six of them made by me for Mr. Pinkham. They were set up for experiment. They were never used outside of the shop where they were made.

Cross-int. 25. In what respect did the principle of your in-
67 vention described in No. 130,770, of Aug. 30, 1872, differ from that described in the two last-mentioned patents?

Ans. It was simplified by using only one magnet to do the whole work. For letting on and lighting gas two electric circuits were used in 1871, in 1872 one electric circuit, and the invention did away with one wire.

Cross-int. 26. Was the principle of your invention set forth in 184,807 intended by you to be that of your 1871 invention or 1872 invention?

Ans. It was an improvement on the 1872 invention in construction.

Cross-int. 27. In automatic electric gas-burners for street purposes you have testified that in your judgment switching mechanism was essential. I suppose you mean, do you not, in cases where more than a single lamp is to be lighted?

Ans. I do.

Cross-int. 28. There would be no occasion, would there, for any switching mechanism for lighting a single burner, whether for out of doors or interior use?

Ans. There would not.

Cross-int. 29. Do you find or do you know of any electric gas-lighting burner made before your burner, described in 230,590, in which the armature was made to both open the gas-valve and move the breaker-piece so as to cause a spark at the burner tip? If so, please state what it was.

Ans. I knew of the Cutler and Sandford burner, described in letters patent No. 211,384, of Jan. 14, 1879, of which I have seen one. This did not operate well. I made for Dr. Cutler a model of the invention described in letters patent No. 220,704, of Oct. 21, 1879. I know of nothing else.

Cross-int. 30. Is there any similarity in principle or in construction between the Cutler device shown in No. 220,704 and the device shown in letters patent No. 230,590?

(Objected to as immaterial, irrelevant, and incompetent.)

Ans. There is a similarity as far as magnets and armatures are concerned. The principle is not the same.

68 Direct examination resumed:

Int. 31. Was there any smaller number of magnets in the appa-

ratus of your 1872 patent than in the apparatus of your 1871 patents?

Ans. There is one magnet less than in patent No. 121,302.

JACOB P. TIRRELL.

Attest: GEORGE B. HASKELL,
Special Examiner.

BOSTON, *March* 19, 1886.

Defendants' counsel offers in evidence a printed copy of a duly certified copy of the file wrapper and contents in the matter of the reissue letters patent of the United States No. 9743, granted Jacob P. Tirrell, assignor to Franklin Electric Gas Lighting Company, June 7, 1881, and the same is marked "Defendants' Exhibit Reissue File, G. B. H., Sp'l Ex'r.;" and it is agreed by the counsel for the respective parties that said exhibit may be printed as a part of the record in this suit, and that thus printed it may be used with the same effect as if a certified copy of said file wrapper and contents had been duly introduced in evidence by the defendants and had been filed as an exhibit in this case.

Deposition of George F. Pinkham.

Direct examination by JOHN E. ABBOTT, Esq., of counsel for defendants:

BOSTON, *March* 19, 1886.

Int. 1. Please state your name, age, residence, and occupation.

Ans. George F. Pinkham; age, fifty-three years; residence, Wollaston, town of Quincy, Mass.; occupation, dealer in real estate.

Int. 2. Are you the George F. Pinkham to whom, as assignee of Jacob P. Tirrell, the four letters patent of the United States were issued, which are numbered and dated as follows: Nos. 121,301 and 121,302, both dated Nov. 28, 1871, and Nos. 230,589 and 230,590, both dated July 27, 1880?

69 Ans. I am.

Int. 3. State, if you know, in whose employ was said Tirrell when he made the inventions for which said four letters patent or any of them were granted which are specified in the last question.

Ans. When he made the inventions for which the two patents 121,301 and 121,302 were granted he was in my employ.

Int. 4. For what purpose was said Tirrell employed by you prior to Nov. 28, 1871?

Ans. For the purpose of constructing and perfecting apparatus for lighting gas by electricity, being the same apparatus for which letters patent Nos. 121,301 and 121,302 were granted.

Int. 5. For about how long a time was Mr. Tirrell employed by you for said purpose?

Ans. For several months.

Int. 6. Please state briefly what experience and knowledge you have had in regard to electric gas-lighting apparatus.

Ans. My first experience was in connection with patents granted

to Edwin E. Bean, perhaps in the years 1868 or 1869. I was interested in a company that was organized for the purpose of manufacturing and using apparatus for lighting street lights—gas-lights—by electricity in conformity with said patents. We placed a series of lights around Boston Common from Park Street church to Charles street, which operated not fully satisfactorily for several weeks. In consequence of the apparatus not being perfected the enterprise was abandoned. Some time after that Jacob P. Tirrell, who had been in the employ of Mr. Bean, came to me saying that he had some ideas with regard to electric apparatus for lighting gas by electricity, which he wished help to carry out or construct. I entered into an arrangement with him, agreeing to pay all the expenses and pay him a certain sum per week. Out of his work grew the two inventions secured by letters patent Nos. 121,301 and 121,302. Those inventions were never put into practical use. From that time I had nothing to do with any apparatus for lighting gas by electricity until about 1878 or 1879, at which time William R. Nutting was endeavoring to introduce apparatus for that purpose. It being called to my attention, and being a matter in which I had been so much interested in former years, I at once took an interest in it, sought out my old associate Tirrell, and through him became the possessor of the inventions afterwards embodied in the two patents Nos. 230,589 and 230,590. I was one of the original incorporators of the Boston Electric Company, to which I assigned the patents Nos. 121,301 and 121,302 for New England, and afterward, when the two patents Nos. 230,589 and 230,590 were issued, I also assigned them to said company for New England. I have not had any financial interest in the Boston Electric Company since the first part of 1880.

I was interested in a company formed in New York, and also in one formed in Chicago, for the purpose of making and selling apparatus for lighting gas by electricity.

Since 1878 or 1879 and up to the present time I have been interested in electric gas-lighting apparatus, and I have frequently examined such apparatus as has been introduced into general use.

Int. 7. Was any apparatus constructed in or about the year 1871 in conformity with that which is described and claimed in said patent No. 121,301? If yea, please state who constructed it, whether it was tested for the purpose of automatically lighting gas by electricity, where, when, and in whose presence such test was made, whether it was tested on more than one occasion, and whether or not the apparatus operated successfully.

Ans. There was. It was constructed by Jacob P. Tirrell. It was tested in the city of Boston, at the shop where Tirrell worked. It must have been in the latter part of 1870 or in 1871. It was tested in the presence of Tirrell and myself and of others whose names I cannot now give, excepting Joseph H. Beale, of Boston, and B. F. Jacobs, of Chicago. It was tested on numerous occasions and operated satisfactorily. That apparatus was sent to Washington as a model with the application for the patent, and I suppose it is now

there. This was the only one of the kind ever made, so far as I know.

Int. 8. Was any apparatus constructed in or about the year 1871 in conformity with that which is described and claimed in said patent No. 121,302? If yea, please give in respect to such apparatus the same particulars as to any test or tests of the same which
71 you were requested in the last question to give as to tests of the apparatus referred to in that question.

Ans. There was. It was constructed by Jacob P. Tirrell. It was tested in the city of Boston, at the shop where Tirrell worked. It must have been in the latter part of 1870 or in 1871. It was tested in the presence of Tirrell and myself. It wes tested on numerous occasions and operated satisfactorily. That apparatus was sent to Washington as a model with the application for the patent, and I suppose it is now there. This was the only one of the kind ever made, so far as I know.

Int. 9. Was apparatus like in its mechanical construction to that referred to in either of the last two preceding questions ever put into practical use?

Ans. No, sir.

Int. 10. What reason, if any, was there why such apparatus was not put into practical use?

(Question objected to, so far as the same calls for expert testimony.)

Ans. I fully believed the apparatus to be practical and capable of being put into practical use, but being actively engaged in other business which required my whole time I let the matter lie dormant, no other person being interested with me in it except Mr. Tirrell, who was not able to do anything with it.

Int. 11. Up to that time had automatic electric gas-lighting apparatus been used for any other purpose than street-lighting, so far as you know?

Ans. It had not.

Int. 12. Was there at that time any considerable demand for such apparatus?

Ans. No; I should say not.

Int. 13. Please state, if you know, whether apparatus constructed in substantial conformity with that described and claimed in letters patent of the United States No. 230,590 has been manufactured and used to any considerable extent for the purpose of automatically lighting gas by electricity.

Ans. It has.

Int. 14. In what ones of the United States, so far as you
72 know, has the apparatus referred to in the last question been so used?

Ans. From my own knowledge it has been used in Massachusetts, New York, Pennsylvania, and Illinois, because I have seen the apparatus in use in those States.

Int. 15. Did such apparatus operate successfully for automatically lighting gas by electricity?

Ans. It did.

Int. 16. Prior to the completing of the invention for which letters patent No. 230,590 were issued was there any other apparatus which, so far as you know, had been used to any considerable extent for automatically lighting gas by electricity and which operated successfully for that purpose? If yea, please state what such apparatus was and whether or not it continued to be manufactured to any extent after July, 1880.

Ans. There was an apparatus manufactured by William R. Nutting under the patent to W. C. Cutler, No. 220,704, which was used to a limited extent. It was not manufactured after July, 1880. I don't think it was manufactured after June, 1879.

Int. 17. Have you ever seen any electric gas-lighting apparatus like that illustrated in the drawings of letters patent of the United States No. 130,770, granted to Jacob P. Tirrell?

Ans. I have, and I have such apparatus now in my hand. It has a tag attached to it (the writing on which I had not seen when I gave the first part of this answer), marked "Tirrell 1872 Burner, W. E. S., examiner, Nov. 4, 1885, Def'ts' Exhibit No. 1."

Int. 18. Have you ever known of apparatus like that referred to in your last answer being used for any other purpose than out-door or street lighting?

(Objected to unless the meaning in the question of the word "like" is made more definite.

Defendants' counsel states that by "like" he means like in mechanical construction.)

Ans. I have never known it to be used for any purpose. I have never seen it in use. I have reason to believe that it was used, and successfully, for street-lighting for a short time, but for a number of years I believe it has not been used for any purpose.

73 Cross-examination by EDWARD P. PAYSON, Esq., of counsel for complainants:

Cross-int. 19. Are you familiar with the improvements on letters patent No. 130,770, described in letters patent of the United States Nos. 184,807 and 206,057, and do you know anything as to the use and operation of both or either of them? And, if so, please state generally your knowledge.

Ans. I have no knowledge concerning them whatever. I don't think either of them were ever put into practical use.

GEO. F. PINKHAM.

Attest: GEORGE P. HASKELL,
Special Examiner.

Evidence for Complainants in Reply.

Taken pursuant to the sixty-seventh rule of the Supreme Court of the United States, in equity, as amended, before me, George L. Prentiss, special examiner.

NEW YORK, *April* 26, 1886.

Present: Edward P. Payson, Esq., of counsel for complainants; John E. Abbott, Esq., of counsel for defendants.

Deposition of Cyrus F. Brackett.

Direct examination by EDWARD P. PAYSON, Esq., of counsel for complainants:

Int. 1. Have you read the testimony of Prof. Morton introduced in this case by defendants; and, if so, how far do you agree or disagree with his answer to Int. 5?

Ans. I have read the testimony, and assuming that he
74 means that the instrumentalities are individually old, but not in the combination set forth in said patent No. 9743, I agree with him that said combination is to produce a certain new effect (which I should not confine to either street gas-lamps or other gas-lamps in series) by means of a single circuit, and I think his answer to cross-int. 18, page 56, shows the points upon which we agree. I do not think that the patents should be limited by either condition, and I should consider him entitled to the use of known equivalents in the organization of an automatic gas-lighter. Although Prof. Morton states that it was old to cause the interruption producing the igniting spark by means of the magnet which turns the gas on, he does not state that it was old to use the current traversing the circuit containing the magnet and vibrator to also cause the igniting spark.

As to the limitation of the invention to the process agencies shown in the drawings, I think they may be utilized for single lights, both as I have stated in my direct examination and as arranged by the same inventor in his later patent of 1876, No. 184,807, or its modification, by switching the turning-on current into the circuit to turn off the gas, and also that any known equivalent for the subordinate device controlling the gas mechanism may be substituted without essentially departing from the invention; and I do not therefore agree that the ratchet and pawl or the shifting device must necessarily be used in order to appropriate the whole or an essential part of the invention.

My main disagreement with Prof. Morton is as to the scope of the patent in view of the state of the art and the language of the specification.

Although in my answer to Int. 6, in my direct examination, I have briefly defined the invention and referred to prior patents, I can better explain my grounds for disagreeing with Prof. Morton and at the same time give my opinion as to the scope of the inven-

tion by referring briefly to preceding automatic gas-lighters. Patent No. 18945, to Gardner, shows an electric magnet, ratchet and pawl for turning the stop-cock of a burner. This is the so-called "step-by-step" movement, fifteen years before the Tirrell patent No. 130,770, of 1872. Patent No. 49254, to Frost and Lawrence, shows an electric magnet, or its equivalent helix, which when
75 actuated draws its polarized core within itself, to which core is attached an arm which turns the gas-cock. Here is a stop-cock operated directly by a magnet nine years before the said Tirrell patent.

In 1870 for the first time a primary spark (to wit, the spark caused by the rupture of an electric circuit) was used in such devices by means of the power of a magnet acting on an armature.

The organization of such an automatic gas-lighter was this: A current of electricity energized a magnet, the magnet attracted an armature, the armature was connected to the gas-cock either directly or by means of a pawl acting on a ratchet connected with the gas-cock, said armature being also arranged to control the breaking of the primary circuit.

By this means two things were accomplished: the gas was let on and the primary circuit was ruptured, but the current which flowed through said magnet did not flow through the circuit-breaker; consequently a second circuit (the circuit to be ruptured to produce a spark) was essential, and a second wire was connected to the circuit-breaker, so that when the circuit-breaker was made to separate by the action of the electric magnet, energized by the first current, a second current was flowing through said circuit-breaker ready to furnish a spark upon the parting of its electrodes.

This will be seen on reference to patent No. 101,491 to Morris and Reid, 1876, and to Nos. 121,301 and 121,302 to J. P. Tirrell, 1871. The first and last opened the gas-cock by direct action of the magnet upon its armature connected with the gas-cock. The second opened the gas-cock by the action of the armature upon the ratchet and pawl. In neither of the three did the current which opened the gas-cock do the other two things, viz., move the vibrator and produce the spark. As I regard this as important in my view of the case, I will be still more specific. Morris and Reid patent shows three electric circuits with a three-part switch, and three electro-magnets. It admits the current to a magnet, B, whose armature thereby operates a rod, which lifts a valve to admit the gas. It then switches the current into another magnet whose armatures vibrate the circuit-breaker, which is itself in circuit with the last-named magnet, thus letting on and lighting the gas by two currents
76 and a distinct operation of the two magnets, each having its own armature and performing a distinct function.

Still a third magnet and armature are used to turn the gas off. The gas-valve is opened by a single movement. In Tirrell, 121,301, a magnet opens the cock by the "step-by-step" movement, and at the same time vibrates the circuit-breaker. This circuit-breaker is not in circuit with the magnet, but with another coil through which another current comes to furnish the spark when the circuit is rup-

tured. To extinguish the gas a current is admitted to the same magnet by means of another and a third wire. The second Tirrell patent, 121,302, dispenses with the ratchet, and the armature of the magnet operates a rod somewhat as in Morris and Reid, which lifts the gas-valve of an auxiliary burner, and also vibrates the circuit-breaker there. A second current passes through the circuit-breaker and furnishes a spark as the circuit is ruptured. It is thus made certain that in 1872 the opening of the gas-cock might be accomplished by the action of the armature directly upon the valve or upon a ratchet connected thereto, and that the art, at the time of the 1872 invention, had not advanced beyond the complications of the three last-named patents; and my main difference with Prof. Morton is (as I understand his testimony) that he limits the Tirrell patent of 1872 to the exact combination shown in the drawings, regardless of the absolutely new mode of operation which seems to me to result in the production of a distinctly new machine, in which the inventor was entitled to the use of known equivalents, which equivalents are fully shown in the patents to which I have referred.

Int. 2. How far do you agree or disagree with Prof. Morton in his answer to Int. 6, as to the Pinkham burner therein referred to, and being substantially the same as Defendants' Exhibit No. 3?

Ans. I do not agree with him, because it seems to me questionable whether, in view of the state of the art in July, 1880, any invention was required to construct said burner, and, secondly, because the differences in construction between it and the original and reissue Tirrell patent Nos. 130,770 and 9743 are substantially found in previous patents; for instance, a single motion of the armature to open the valve is found in Morris and Reid, No. 101,491, and in Tirrell, No. 121,302, and in Cutler, No. 220,704. It therefore seems
77 to me that, notwithstanding the immaterial differences of structure, what I have said of Complainants' Exhibit Defendants' Burner applies to this.

Prof. Morton says it has no means of shifting the current, which seems to me, with my understanding of the Tirrell invention, as already explained, to be quite immaterial.

This second objection, that it does not turn the gas on and off by the operation of an automatic interrupter, is met by saying that the substituted equivalent requires no such interrupter, since it opens the gas-valve with a single impulse, but the spark-producing mechanism requires and utilizes such an interrupter.

To his third objection it may be replied that the duplication of magnet would not be invention, even if it had not been already used, as, indeed, it had been. In his fourth objection Prof. Morton only explains the nature of the equivalent already referred to. His fifth objection is only another way of stating his last or fourth. The essential point here is that this Pinkham burner accomplishes the turning on of the gas, the vibration of the circuit-breaker, and the making of the spark by means of a single circuit.

His sixth objection seems to me to be a misconception if the machine be used to both turn on and light the gas, for if this be done there must be an interrupter in the circuit.

As to the statement that the interrupter is only made operative after the gas is turned on, it may be said that without it there would be no completed circuit, and hence the device would not be operative, even to turn the gas off. I do not agree with Prof. Morton in his statement that the essential principle of the Tirrell and Pinkham devices is entirely different. It is true, as he says, that the gas is turned on before the occurrence of the spark by which it is lighted. I do not conceive it to be true that "in the Pinkham device successive currents and different parts of the apparatus successively brought into operation are used to perform these two operations," for there is but one act of the lighting button which turns the current into the gas-lighter, after which it is left to its own operation, which is wholly determined by the adjustment of the subsidiary apparatus.

78 That the whole current is first made to act to turn the valve and subsequently to control the circuit-breaker instead of acting simultaneously to do both is, I think, of no consequence.

The total time occupied in turning on the gas and lighting it would be about the same in either case. It is a fanciful and not a practical distinction; and, further, it is an immaterial distinction, since the Tirrell patent is not for an order of events in a method of operating, but for an organized practical machine embodying for the first time, as Prof. Morton himself substantially admits, the idea of employing a single circuit in the place of at least two circuits.

Int. 3. How far do you agree or disagree with Prof. Morton in his answer to Int. 7, so far as the same compares the inventions of the first claim of Tirrell original patent 130,770 with the fifth claim of the reissue thereof, No. 9743?

Ans. There are two reasons for disagreeing with his construction of the first. (I.) That the movement of the circuit-breaker results in shunting the current to the next burner would not make such circuit-breaker novel. Prof. Morton has overlooked, apparently, the patent of Morris and Reid, No. 101,491, in which "the next instrument does not receive the current until the lever P moves, severs its connection, *c* R, and forms the connection h^1." This lever P and its platinum tip E constitute the circuit-breaking piece in said patent. (II.) In my direct examination I have explained what seems to me, in view of the state of the art, clearly embraced in said original first claim and its identity with the subject-matter of the reissue claim 5.

Int. 4. How far do you agree or disagree with Prof. Morton's answer to Int. 14, as to the invention set forth in letters patent 230,590?

Ans. I agree that there is no essential difference "between the action of two magnets alternately acting on one armature swinging between them and the action of two magnets on two armatures rigidly connected and rocking over the magnets, etc." Prof. Morton thus says, "In the present case, however, the armature is not directly connected with the gas-valve, but only operates on it through a fork

straddling a pin in such a manner as to allow a considerable movement of the armature to be made without any effect on the gas-valve. This combination is new at the date of the patent, and
79 confers new and beneficial capacities on the combination. For example, it allows the armature to acquire a certain momentum before it is required to move the gas-valve, and thus insures its successful operation at all times. This same new feature allows the armature to make minute and repeated vibrations sufficient to actuate an interrupter and produce a spark without its affecting at the same time the flow of gas."

Prof. Morton seems to have overlooked the use of a fork straddling a pin in the manner pointed out in the Morris and Reid patent No. 101,491, when he declares this combination to be "new at the date of this patent." The supposed advantages set forth by Prof. Morton resulting from "a certain momentum before it is required to move the gas-valve" seem to me to be very trifling, or rather wholly immaterial, as does also his suggestion with reference to "repeated vibration sufficient to actuate an interrupter and produce a spark without its affecting at the same time the flow of the gas." Prof. Morton's declaration respecting the contact piece for producing sparks at the burner tip seems to me to be without sufficient foundation. He declares that it is "new in its combination with the armature (in present patent), because, in the present case, it is not in constant contact with the armature, and therefore affected by all its motions, but only comes into contact with the armature and co-operates therewith when the latter reaches nearly the end of its motion in the direction of turning on the gas." Upon these considerations he bases this declaration: "By reason of this arrangement many advantages are secured and the mode of operation is radically changed." He then gives illustrations of the advantages and changes alluded to: "Thus, during nearly all its operations the armature has no connection with this break-piece, and therefore performs its functions freely and not as a part of an automatic interrupter, but as an attracted armature moving simply and positively in one direction or the other. It is thus enabled to perform its functions of opening and closing the gas-valve in a simple and direct manner, which would be impossible with any armature which was constantly attached to and co-operating with or forming, in fact, part of an automatic interrupter." To which I reply that it is not evident how the mode of operation is radically changed while there still
80 is used but a single current to turn on the gas, actuate the circuit-breaker, and cause the spark, the whole being done by a single act of the push-button in the case of either apparatus and by the use of the same or equivalent devices. I therefore cannot think that the apparatus in question "performs its various essential functions in radically new ways as compared with either of the patents involved in this suit."

Int. 5. Do you agree with Prof. Morton, in his answer to Int. 16, that only a "slight" change would be necessary to secure one circuit in place of two, in the apparatus shown in Morris and Reid patent No. 101,491?

Ans. I do not; such a change, it seems to me, would involve the conception of an apparatus having an entirely distinct mode of operation. If what he meant to say was that the structural changes involved would be slight, I reply that is often the case; for instance, the change from a common sewing needle to a sewing-machine needle might be regarded as slight, since it would result in merely making the point on the same end as the eye, or, if you please, result from simply inverting the needle from its ordinary use.

Int. 6. Referring to testimony of Mr. Freeman, taken in behalf of the defendants in this case, and particularly to his answer to Int. 13, please state how far you agree or disagree with the same as to his comparison of Exhibit Defendants' Burner with the invention set forth in reissue patent No. 9743.

Ans. In so far as I have already given my views as to the subject-matter, it is not necessary to restate them. His answer does not attempt to deal with the questions of equivalents, but is confined to a comparison of the form of construction and details as usually happens in modifying an apparatus by improving it or by substituting equivalents for subsidiary devices. Mr. Freeman shows some variation in these details, most of them mere variations, as it seems to me, the general organization and mode of operation remaining the same, and so far as he specifies variation or difference of broader significance he seems to be in error. For instance, he states that "in the defendants' device the operation of turning off the gas is entirely independent of the spark-producing device;" and yet but for that spark-producing device, which must include the armature,
81 there never would be any gas turned on to allow the defendants "the operation of turning off the gas."

An embodiment of the original first claim and the reissue claim (5) five, as I understand it, is perfectly evident in the exhibit, and the same is true of original two (2) and reissue four (4), if the complainants are entitled to well-known equivalents to ratchet and pawl for turning on the gas.

So, too, his statement that "in defendants' device there is no lever carrying the circuit-breaker" seems to be a misconception of the mechanical action of the armature, which I have defined in my direct examination as a lever of the third order.

Int. 7. In view of the answers of Mr. Freeman to Ints. 14 and 15, have you any modification to make in your direct testimony in this case as to infringement by defendants' burner of original claims I and II of patent No. 130,770 and claims four and five of reissue No. 9743?

Ans. I have not. I have already shown that a construction limiting the novelty of original claim I to a circuit-breaker, under whose operation the current is shifted to another apparatus, is impossible, in view of the state of the art, and totally inadequate to the invention shown in the said original patent, and that a lever adapted and arranged to open and close the stop-cock and carrying the circuit-breaker is substantially found in the duplicated armature of the defendants' burner. Construing the fifth claim, as I have done in my testimony, as calling for what, in view of the state of the

art and the specification said first claim should mean, I am unable to find any expansion of the claim.

Int. 8. Referring to Defendants' Exhibit Crockett Patent and to Mr. Freeman's answer to Int. 12, please state whether or not, in your opinion, the substantial construction and operation of the apparatus therein described and claimed and as found in Complainants' Exhibit Defendants' Burner does or not differ from the construction and mode of operation of the apparatus set forth in original Tirrell patent No. 130,770, in claims I and II thereof, and reissue patent No. 9743 and claims IV and V.

82 Ans. The construction and operation of the Complainants' Exhibit Defendants' Burner, as described by the witness referred to, are in general, I think, sufficiently accurate. Some minor points on which he insists do not appear to me to be of sufficient importance to be taken into account, much less to form a ground for discrimination, in accordance with which it may be claimed that the apparatus embodies anything novel and not embraced in the claim of the original and reissue patent.

Cross-examination by JOHN E. ABBOTT, Esq., of counsel for defendants:

Cross-int. 9. You have testified in your direct examination that the first compound circuit-breaker is shown in patent No. 108,434, to Frank Bean. In view of that patent, and particularly of its third claim, does or does not apparatus like the Exhibit marked "Tirrell's 1872 * * * Burner Defendants' Exhibit No. 1" embody any invention covered by said Bean patent?

Ans. Inasmuch as in the Bean device alluded to in the question one source of mechanical power is utilized in the shape of compressed air to do the strictly mechanical part of the work, while a current of electricity is led to do the other essential part, namely, to create a spark to light the gas, and inasmuch as in the automatic gas-lighting apparatus of Tirrell these two appliances are unified so that instead of having both a tube and a wire a wire alone may be used for both turning on the gas and lighting it, it would seem that some invention has been made, at least a great simplification in the apparatus. It perhaps should be stated that the Morris and Reid patent is dated April 5, 1870, and the one to Bean is dated Oct. 18, 1870, though I suppose these dates do not exactly fix the date of the invention of either.

Cross-int. 10. Do not the specification and drawings of patent No. 184,807, to Tirrell, show switching mechanism for automatically shifting the electric current in a similar manner and for the same purpose as is described in patent No. 130,770?

Ans. Yes.

Cross-int. 11. When but a single burner is to be lighted with apparatus constructed in accordance with the specification and

83 drawings of said patent No. 130,770 what effect is produced upon the electric current by the switching mechanism therein shown and described after the gas has been fully turned on?

Ans. One skilled in the art would so arrange this gas-burner that after turning on and lighting the gas the current would be either grounded or sent back to battery by suitable return wire.

Cross-int. 12. Is it not stated in the specification of patent No. 121,302 that "when contact between pin n' and springs m' m' is made and broken, as the rod I is raised, the sparks are produced as required"? And is not the arm O raised in order to make and break contact between said springs and the said pin, which pin is at the upper extremity O, by the same current which opens the gas-valve and by means of the pawl T, pivoted to the arm 29, secured to the armature *a*?

Ans. It is.

Cross-int. 13. Does the fork straddling the pin in the Morris and Reid patent allow, as does the fork straddling the pin in patent 230,590, "a considerable movement of the armature to be made without any effect upon the gas-valve"?

Ans. The language of the patentee, which I quote sufficiently for our present purpose, is "a fork at its upper extremity, in which rests the pin J of the valve crank K, which, through the medium of its arbor *a* and the inner lever *b*, raises the valve D to its seat." This language might be taken to mean that the pin J rests in the fork of necessity, thus leaving no movement of the one without corresponding movement of the other. Such construction is, however, in my opinion, a matter of indifference, as the movement of the valve to its seat would be equally accomplished, though some space were left in the fork not filled by the pin. Evidently the literal construction of the language of the patentee is not necessary to the fulfilment of its purpose, provided only the fork and the pin I move sufficiently far in common to lift the valve to its seat.

Cross-int. 14. Does not claim 2 of patent 130,770 cover a combination of more elements than claim of said patent?

Ans. Undoubtedly, since the language is, "in combination with the above," meaning claim 1, and thus names it additional element.

Cross-int. 15. Without the lever of claim 2 or some equiva-
84 lent for said lever would the device referred to in and covered by claim 1 of said patent be operative for any of the purposes specified in the patent?

Ans. The purpose being to turn on light and extinguish the gas, clearly some device for this purpose must be present, which must be a lever or its equivalent.

Cross-int. 16. Has claim 2 of the reissue patent No. 9743 its foundation in any other claim of the original patent 130,770 than claim 1 of said original?

(Objected to as irrelevant on cross-examination.)

Ans. I do not see that it has.

C. F. BRACKETT.

Attest: GEORGE L. PRENTISS,
Special Examiner.

Further Evidence for Defendants.

Taken pursuant to the sixty-seventh rule of the Supreme Court of the United States, in equity, as amended, before me, William A. Harries, special examiner.

WASHINGTON, D. C., *April* 22, 1886.

Present: Edward P. Payson, Esq., of counsel for complainants; John E. Abbott, Esq., of counsel for defendants.

Deposition of Frank L. Freeman.

Direct examination by JOHN E. ABBOTT, Esq., of counsel for defendants:

Int. 1. Please state your name, age, residence, and occupation.

Ans. Frank L. Freeman; thirty-eight years; Washington, D. C.; attorney-at-law and counsel and expert in patent causes.

Int. 2. What experience have you had in the examination of letters patent and of apparatus involving the application of electricity?

85 Ans. For some years previous to 1880 I was a principal examiner in the United States Patent Office. In 1880 I was put in charge of the class of electricity in said Patent Office, and continued in that position until my resignation, in 1883. During that time I was almost continuously employed in examining applications for patents and patents relating to electrical devices. Since my resignation up to the present time I have been practicing my profession, devoting myself especially to matters involving electrical inventions and patents therefor. In 1881 I was appointed by the President one of the United States commissioners to the International Exposition of Electricity, held in Paris that year, which exhibition I attended for about four months, making a special study of the electrical apparatus there exhibited and acting as a member of the jury of awards. Since my resignation from the Patent Office I have often been called upon to give, and have given, opinions upon the scope and validity of inventions and patents relating to electrical devices, and have made affidavits and testified as an expert in causes relating to patents in the United States courts.

Int. 3. Have you read and do you understand letters patent of the United States granted to J. P. Tirrell, dated Aug. 20, 1872, and numbered 130,770, and do you understand the invention therein described and claimed?

Ans. I have read said patent, and think I understand the invention therein set forth.

Int. 4. Have you read and do you understand reissue letters patent numbered 9743, dated June 7, 1881, being the reissue of the original letters patent referred to in the last question?

Ans. I have read said reissue patent, and think I understand the invention therein set forth.

Int. 5. Please compare said original patent No. 130,770 with the

said reissue thereof and state what differences and what similarities, if any, you find as the result of such comparison.

(Objected to, so far as said question covers matters as to which there is no testimony in complainants' case, and also as irrelevant unless confined to claims four and five of said reissue.)

86 Ans. I have compared said patent and reissue, and I find that the drawings connected to and forming part of the same are exactly alike, with perhaps the exception that the drawings connected with the reissue are made upon a smaller scale than those connected with the patent. I find also that the respective specifications are alike, being practically *verbatim* copies, the only variation being in stating the residence of the inventor. Comparing the claims of the said patent and reissue, I find that claim three of the patent has been reproduced as claim three of the reissue, the only difference between the two claims being the omission of the reference letter R after the word ratchet wheel in the fourth line of said claim in the reissue, which letter appears in the claim of the original patent. I do not find any claim or claims in the reissue corresponding to claims one and two of the patent.

Int. 6. Have you examined and do you understand the construction and mode of operation of the two exhibits now shown you, which are marked respectively "Complainants' Exhibit Defendants' Burner, W. E. S., Ex'r, Nov. 3, 1885," and "Tirrell 1872 Burner, W. E. S., Ex'r, Nov. 4, 1885, Defendants' Exhibit No. 1"?

Ans. I have examined said exhibits, and think I understand the construction and mode of operation thereof.

Int. 7. Is Defendants' Exhibit No. 1, referred to in the last question, constructed in substantial conformity with the specification and drawings of said reissue patent No. 9743 or not?

Ans. It is in all essential features. I notice some slight variance in the construction of the so-called finger pieces h and h^2 and contact pins m and m^2 in the drawing, though the function and mode of operation of the exhibit burner are the same as the corresponding parts shown in the drawing. I also notice that the so-called circuit-breaker varies in some respects from the circuit-breaker shown in the drawings in the reissue and lettered J. In the said drawings the part marked "J" is represented as a small continuous rod bent at the upper end. In the exhibit burner said part is made of two pieces of wire joined by a block of metal, to which said pieces are connected and secured by screws, and the upper bent piece of wire is partially insulated. I do not find in the drawing any holding pawl bearing upon the ratchet wheel R similar to that shown in the exhibit burner. With these few exceptions
87 the exhibit burner is constructed in substantial conformity with the specification and drawings of said reissue.

Int. 8. In your opinion does said exhibit embody the invention set forth and claimed both in said reissue patent and also in the original patent No. 130,770?

Ans. It does.

Int. 9. Have you read and do you understand patent No. 281,345,

dated July 17, 1883, granted to Charles H. Crockett, assignor to the Boston Electric Company, and do you understand the invention therein described and claimed?

Ans. I have read said patent, and think I understand the invention therein set forth.

Int. 10. Referring to the exhibit marked "Complainants' Exhibit Defendants' Burner," please state whether or not that exhibit is constructed in conformity with said patent No. 281,345 and whether or not it embodies the invention set forth in said patent.

Ans. I have examined said exhibit, and find that it embodies the invention set forth in said patent.

Int. 11. Please describe the mode of operation of the invention set forth in said reissue patent No. 9743, and which you have testified is embodied in the exhibit hereinbefore referred to as Defendants' Exhibit No. 1, and in your answer you may designate the parts of the exhibit by the letters which are used in the specification and drawings of the patent to denote the corresponding parts in the drawings.

Ans. The mode of operation of the invention described in said reissue patent is set forth therein in somewhat general terms as follows:

"This invention relates to that class of electrical apparatus for lighting street lamps in which the current is successively thrown into the magnet at each burner one after another, and under this invention the circuit-breaker is located at the burner, and by the direct action of the current through the magnet located at the burner the circuit-breaker and the valve to let on or turn off the gas are both operated, and the current, after the opening or closing, as the case may be, of the valve to one burner, is completely cut off from
88 the magnet of such burner and thrown into the magnet of next burner, and so on."

(Adjourned.)

APRIL 23, 1886.

In describing the operation of the device I will refer to Figs. 1 and 2 of the original patent to Tirrell. The line wire connected with the push-button or other operating device enters the apparatus at the point lettered M, and thence passes to the arm O, and the parts being in the position illustrated in Fig. 1—that is, with the gas turned off and the electrodes *a b* in contact and the lever O resting upon the enlarged part of the sector wheel *f*—the circuit passes by the finger piece *h*, pin *l*, and wire T to the magnet coils F, and thence by the wire U to the lever H, carrying the circuit-breaker J, and through the electrodes *a b*, post K, to the frame of machine, and thence to ground. This being the normal condition of the apparatus, when the circuit is closed at the distant or operating station, the current of electricity passes over the line circuit just described, energizing the magnet E and causing it to attract the armature G secured to the lever H.

As the armature and the lever H are moved toward the magnet the pawl S engages the ratchet wheel R, which is attached to the

valve and carries the sector wheels *f n*, and propels the same a distance of one tooth of said ratchet wheel. The circuit-breaker J, being attached to the upper end of the lever H, is moved with said lever, and as a consequence the electrodes *a b* are separated, thus breaking the circuit through the magnet, and the lever H, with its appendages, are restored to their normal condition by gravity, aided by the spring L. As soon as this condition is attained the electrodes *a b* are again in contact, and if the circuit-closer at the operating station is still held closed the magnet E is again energized and the armature attracted and the lever operated to again move the ratchet wheel R one tooth and to break the circuit at the electrodes *a b* as before. This operation of making and breaking the circuit at the electrodes and the step-by-step movement of the ratchet wheel operating the valve and sector wheels continues as long as the circuit is closed at the operating station or until the sector wheels are rotated through a half of a revolution, allowing the lever O to escape from the periphery of the sector wheel *f*, when the circuit previously
89 described through the magnet is permanently broken and another circuit established by means of the finger piece *h* making contact with a pin, *m*, through the wire V to the line connecting the next burner in the series. At the same movement the arm Q has reached the periphery of the sector wheel *n* and a new circuit is established through the wire N, the finger piece h^2, pin l^2, the wire T, thence through the coils F, wire U, lever H, circuit-breaker J, electrodes *a b*, and post K to ground. This last circuit is the turning-off or extinguishing circuit, and when this operation is performed the circuit through the magnet is alternately made and broken at the electrodes by the movement of the lever H in precisely the same manner as it was in turning on and lighting the gas, and the ratchet wheel operating to close the valve is propelled step by step by the lever H and in the same direction that it was moved in turning on the gas. This operation continues as long as the circuit is closed at the operating station or until the ratchet wheel has made a half revolution and the arm Q has escaped from the periphery of the sector wheel *n*, when the extinguishing circuit is automatically broken and the turning-on and lighting circuit automatically re-established, and the parts are in the normal condition shown in Fig. 1, before referred to.

Int. 12. Please describe the mode of operation of Complainants' Exhibit Defendants' Burner, both in turning on and lighting the gas and in turning off the gas, and in your answer you can designate the parts of the exhibit by the letters of reference used for the corresponding parts in the patent granted to Charles H. Crockett, assignor, No. 281,345.

(Counsel for defendants offers a copy of said patent in evidence, and the same is marked "Defendants' Exhibit Crockett Patent.")

Ans. I find in said exhibit two independent horseshoe electromagnets, each having its own separate conductor leading from the transmitting or operating station. These magnets are respectively located on opposite sides of the burner, and each has its own arma-

ture pivotally mounted in posts connected to the base plate. A rocking valve, D, controlling the flow of gas to the burner, is provided with two small pins, *c*, projecting laterally from the end of the valve, and adjustable stop pins, *d*, secured to the base, are
90 arranged to check or limit the movement of the valve D in turning on or shutting off the flow of gas. Each of the armatures E E^1 is provided with an extension or pin, *e*, so arranged that when one of the armatures is tilted or moved by the magnet it will strike one of the pins *c* of the valve, thereby turning the valve so as to open it, and when the other armature is tilted it will strike the other pin on the valve and shut off the flow of gas. Secured to the burner tip is a fixed electrode, I, and a vertically moving electrode, K, normally resting upon the fixed electrode, being held in position by the spring M, while the lower end of the movable electrode extends downward into a position adjacent to the face of the cores of the magnet G and into a position to be struck by the pivoted armature E just before it completes its upward movement when operating to turn on the gas. One circuit from the operating station enters the burner, passes around the magnet G, thence to the fixed electrode J by the insulated wire F, thence to the movable electrode K to the frame of the burner and to ground. This is the turning-on and lighting circuit, and when said circuit is closed at the operating station the magnet G is energized, the pivoted armature E is attracted, and, after moving a slight distance and acquiring a certain momentum, the armature comes in contact with one of the valve pins, imparting thereto a blow which easily moves the valve to open the same. The armature, continuing its movement, gives a sharp blow to the lower end of the movable electrode, causing it to move away from the fixed electrode, breaking the circuit at that point and producing the spark.

The circuit being thus broken, the armature is released from the magnet and the movable electrode falls to its normal position, completing the circuit, and, if the circuit remains closed at the operating end, the armature E will continue to vibrate, causing a spark at each vibration at the burner, but not affecting the valve. Thus it will be seen that the valve is completely opened and the lighting spark is produced by a single impulse or break of the circuit, and successive makes and breaks, if produced, do not produce any effect on the operation of the valve.

The turning-off or extinguishing circuit includes the coils of the magnet G^1 and goes thence directly to ground and is independent of the turning-on and lighting circuits. When said circuit
91 is closed at the operating station the magnet G^1 is energized and the armature E^1 is operated to strike one of the pins on the valve and to turn off the gas at a single impulse, and the circuit through the magnet G^1 is closed as long as the push-button at the operating station is depressed, there being no automatic break in the circuit.

Int. 13. Please compare the exhibit burner referred to in the last question with the invention set forth in said reissue patent, and state what similarities or dissimilarities you find between them.

Ans. Perhaps I could best answer this question by first pointing out the dissimilarities in construction and operation between the two devices referred to. I will speak of the device illustrated in the reissue as complainants' device and the one referred to in the exhibit as defendants' device. In the complainants' device the gas is turned on by a progressive or step-by-step movement, caused by the make and break of the circuit, while in defendants' apparatus the gas is turned on by a single impulse or a single closing of the circuit. In complainants' device it is necessary to produce a series of attractions or makes and breaks in the electro-magnet and the circuits thereof before the gas can be fully turned on, while in defendants' device a single attraction of the magnet operates to turn the valve completely on. In complainants' device, by which I mean a device embodying the invention set forth in reissued patent No. 9743, as I have stated in my previous answer, a spark is formed at the burner tip at each progressive step of the movement of the valve upon being opened, while in defendants' device a spark is not formed at the tip of the burner until the valve is practically, if not fully, open. In complainants' device the sparks at the burner tip cease the moment the valve is fully open, notwithstanding the circuit is closed at the operating station. In defendants' device the spark continues as long as the circuit remains closed at the transmitting station without effecting the movement of the valve.

In complainants' device the valve-actuating mechanism and the spark-producing mechanism operate conjointly and cannot operate independently of each other, while in defendants' device the valve can be moved independently of the sparking device, and the sparking device, when the valve is open, can be operated independently of the valve. In complainants' device sparks are produced
92 at each movement of the ratchet wheel in turning off the gas, while in defendants' device the operation of turning off the gas is entirely independent of the spark-producing device. In complainants' device the lever and circuit-breaker connected thereto must operate conjointly at every movement in turning on or turning off the gas, while in the defendants' device the circuit-breaker or movable electrode operates entirely independent of the turning-off device, and may operate independently of the turning-on device. In complainants' device the lever which operates the turning-on device carries the sparking or lighting device, while in defendants' device there is no lever carrying the circuit-breaker. In complainants' device the same magnet is used both to turn on and light the gas and to extinguish the same, while in defendants' device entirely separate and independent magnets are used to turn on and light the gas and to extinguish the same. Complainants' device was intended and is adapted to operate in a series of burners, and is provided with mechanism for throwing the currents successively from one burner to another, while defendants' device was not so intended and cannot so operate, as no means are provided for accomplishing this result.

In complainants' device this means for shifting the current from one lamp to another is essential; otherwise the device would not be

operative in the manner shown and described in said reissued patent. If said mechanism for shifting the current were removed from complainants' device no means would be provided for turning off the gas or turning it on with any degree of accuracy, as upon the closure of the circuit at the operating station the lever and electrode would continue to operate and to propel the ratchet wheel connected to the valve as long as the circuit remained closed, and it would be very difficult, if not impossible, to operate the device so as to exactly open and close the valve, even by one skilled in operating the same, and when the burner was in sight and when the burner was not in sight there would be nothing to indicate to the operator whether the gas was turned on or off; in defendants' device, on the contrary, the operations are definite and exact and require no skill or sight of the burner. It is necessary, in complainants' device, that sparks should be produced on closing the valve, as well as upon opening it, as
93 otherwise the mechanism shown would be inoperative to close the valve. In defendants' device the spark is not produced upon closing the valve and cannot be, as before stated. In complainants' device, while there may be two circuits from the transmitting or operating station to the burner, both circuits lead through the same electro-magnet at the burner and through the electrodes, while in defendants' device each of the two circuits from the operating station is independent of the other and passes through separate and distinct elective magnets in the burner. In complainants' device, while the valve is moved step by step, each step is a steady movement, and the electrodes are separated in what might be said to be a gradual manner. In defendants' device, however, the valve is moved by a sharp, quick blow, and the electrodes are also separated forcibly by a blow, thereby better insuring a spark and the movement of the valve.

Int. 14. In your opinion does Complainants' Exhibit Defendants' Burner infringe any of the claims of said original patent No. 130,770? In your answer please give briefly your reasons for your opinion.

(Objected to so far as the question calls for reference to the third claim of said original patent.)

Ans. The first claim of said original patent is as follows:

"1. A circuit-breaker located at the burner and operated automatically, substantially as described."

In answering the question it is necessary to put a construction upon said claim. The only element definitely stated in said claim is a circuit-breaker, and this is qualified by the words "located at the burner and operated automatically;" and, further, the whole is qualified by the term "substantially as described." If the circuit-breaker covered by the claim refers merely to a circuit-breaker or sparking device located at the burner and operated automatically—that is, to open the circuit at that point—I think it might be said that defendants' burner would infringe; but if the claim were to be so construed it would, in my opinion, be totally invalid in view of the fact that the state of the art shows many such circuit-breakers located at the burner and operated automatically, being shown,

among other patents, in patents Nos. 121,301 and 121,302, granted to J. P. Tirrell.

94 If the claim is to be construed to cover the circuit-breaker located at the burner and operated automatically, whereby the current is successively thrown into the magnet of each burner of a series one after another, the claim is, in my opinion, also invalid in view of the state of the art; but under this construction, whether invalid or not, defendants' burner would not infringe, as no means are shown, automatic or otherwise, for breaking the circuit and shunting it into the next succeeding burner. It thus appears that if said first claim is to be sustained at all in view of the state of the art it must be limited by the words "substantially as described," which refer to the specification and drawing, and the claim must be construed as limited to a circuit-breaker located at the burner and operated automatically by the specific means therein set forth or by equivalent means known to be equivalent at the time of said patent and having the same mode of operation; and under such a construction, in my opinion, defendants' device does not infringe. In other words, under any construction by which it is possible to consider the first claim as a valid claim, defendants' apparatus does not infringe.

The second claim of said patent is as follows:

2. "In combination with the above, a lever adapted and arranged to open and close the stop cock or valve of the burner, and carrying the circuit-breaker, substantially as herein described."

In my opinion defendants' device does not infringe said claim either in terms or in any proper construction that can be put upon it; and the reasons may be stated briefly to be that defendants' device shows no lever or known equivalent thereof "adapted and arranged to close the stop-cock of the burner;" nor does it show a lever "carrying the circuit-breaker," nor does it show "a lever adapted and arranged to open and close the stop-cock and carrying the circuit-breaker," nor does it show a combination of devices adapted and arranged to operate substantially as described in the said patent.

Referring to the third claim, it may be sufficient to say that it is a specific claim, specifically naming numerous elements which inspection will show have no counterpart or equivalent in the defendants' device.

95 Finally, I may say that in my opinion defendants' device does not infringe any of the claims of the original patent of Tirrell under any proper construction.

Int. 15. Does said exhibit burner infringe any of the claims of the reissue patent No. 9743?

Ans. In answering this question I will not refer specially to claims one, three, and six of said reissue patent, for, though I am clearly of opinion that said burner does not infringe any one of these claims, I understand that complainants do not allege that said burner infringes any of the said three claims. Claim four is in the following words:

"4th. In an apparatus for lighting gas by electricity, in combination with a circuit-breaker located at the gas-burner, a lever

adapted and arranged to open and close the stop cock or valve of the burner and carrying the circuit-breaker, substantially as herein described."

In my opinion defendants' burner does not infringe said claim either in terms or in substance, as it has no "lever adapted and arranged to open and close the stop cock or valve of the burner," nor a lever "carrying the circuit-breaker," nor does it have a combination of devices such as are named in the claim adapted and arranged to operate substantially as described in said reissue specification.

Referring to claims two and five, I find they are expressed in somewhat broad and vague terms and contain no reference to the specification, and I am of opinion that if said claims can properly be construed as covering a combination of devices embraced in the broad terms of said claims that defendants' burner would infringe. In other words, reading said claims and applying the language therein contained to said burner, I find contained in said burner all the elements enumerated in said claims. It may be proper to here remark that I find no claim or claims in the original patent corresponding to said second and fifth claims of the reissue, and if said claims are to be construed in the manner I have indicated above they will cover an invention not claimed in the original patent, and are, in my opinion, expansions over said original patent.

96 Cross-examination by EDWARD P. PAYSON, Esq., of counsel for complainants:

Cross-int. 16. What is or are the elements or element of claim one, Tirrell original patent, under your construction of the same?

Ans. Of course the elements embraced in said claim would depend upon whichever of the three ways that I have indicated above said claim should be construed. If you refer to such a construction of the claim that it might be sustained in view of the state of the art as I have above indicated, and as included in the reference to the specification, and if the words "operated automatically" refer simply to the operation of the circuit-breaker at the tip of the burner and not to the automatic shunting of the current to the next light, the elements included might be said to be the circuit embracing the coils of the magnet, the magnet, the armature, the lever carrying the armature, the circuit-breaker connected to and carried by the lever, the electrodes *x*, and the post and frame of the machine, together with the retracting spring connected to said lever.

I do not find the word "automatically" in the body of the specification in connection with any description of the operation of the device, and as the term "automatically operated," referring to a circuit-breaker, may mean the automatic shifting of the current from one lamp to another, and especially as the invention is stated to refer particularly to that class of apparatus for lighting lamps in which the current is thus automatically shifted, it may be that the first claim would have to be construed to include, beside the elements stated above, the elements necessary for turning on the gas

and automatically breaking the circuit and closing the line to the next lamp in the series.

Cross-int. 17. Do you think that for the embodiment of the invention more than one lamp is essential?

Ans. The specification states that the invention relates to a series of gas-lighting apparatus in which the current is successively thrown into the magnet at each burner one after the other, and if you mean, under that construction, that it is necessary to show two burners provided with the devices described and connected together, to show an embodiment of the invention, I should answer in
97 the negative, as, in my opinion, to show a single burner arranged and adapted to be so connected in series would be a practical embodiment of the invention described in the patent.

Cross-int. 18. Do you consider it essential to such embodiment that such single burner should be so arranged as to shift the current into another burner?

Ans. That seems to be the only embodiment of the invention shown or described in the specification.

Cross-int. 19. Do you know of any earlier patent in which the circuit-breaker is located at the burner, and by the direct action of the current through the magnet located at the burner the circuit-breaker and the valve to turn on the gas are both operated and operated so as to vibrate said breaker, turn the gas-cock, and produce the electric spark?

Ans. I understand you to mean that a single continuous circuit passes through an electro-magnet at the burner and produces the effects stated, and if that is the proper understanding of the case I do not know of any prior patent showing that exact combination.

Cross-int. 20. Then do you not think that said circuit-breaker may be a novel device, regardless of whether it does or not assist in switching the current into another burner?

Ans. If you mean by the question that the circuit-breaker itself is a novel device, as before stated, I do not think it is. If you mean that the circuit-breaker operating as stated in cross-int. 19, as I answered, I do not know of any prior patent showing that combination.

Cross-int. 21. Referring to claim five of the Tirrell reissue, do you not find that it calls for such an organization in an automatic electric gas-lighter as that referred to in cross-int. 19?

Ans. Claim five of the reissue, as I understand it, calls for the following elements: 1, a wire through which the current of electricity is passed; 2, actuating mechanism for letting on the gas; 3, an electro-magnet electrically connected with the wire; 4, an armature operated by said electro-magnet; 5, mechanism actuated by said armature, breaking the circuit at the burner tip and producing there an electric spark or sparks for lighting gas, the whole
98 combination operating automatically. If the organization referred to in cross-int. 19 was intended to embrace such elements I should answer in the affirmative.

Cross-int. 22. Do you think that actuating mechanism for letting on gas is an element of said claim?

Ans. I think it is.

Cross-int. 23. Will you please answer the last question but one, assuming that it is not an element of said claim?

Ans. If the elements designated "actuating mechanism for letting on the gas" were omitted from claim five of the reissue there would be no means included in the claim for turning the gas cock or valve to turn on the gas, as stated in cross-int. 19.

Cross-int. 24. But everything else than such means would then be found in said claim, would they not?

Ans. I do not find in said claim any words limiting the electro-magnet to a location at the burner, though there is a limitation to the circuit-breaker at the burner tip, and as far as the terms of the claim are concerned it would not necessarily include the exact combination stated in cross-int. 19.

Cross-int. 25. In defendants' burner the gas-cock and the circuit-breaking piece are both set in motion by the armature of a magnet to let on the gas, move the circuit-breaker, and produce the spark, are they not?

Ans. They are.

Cross-int. 26. The circuit-breaker and the valve to turn on the gas are both operated by a current which traverses a circuit leading through a magnet located at the burner and the circuit-breaker, at which, when said circuit is ruptured, the spark is made; is that so?

Ans. It is.

Cross-int. 27. What are the elements, in your opinion, of reissue claim four?

Ans. The elements called for in claim four of the reissue seem to be: 1, a circuit-breaker located at the gas-burner; 2, a lever adapted and arranged to open and close the stop cock or valve of the burner and carrying the circuit-breaker. These are the only two elements specifically so stated in the terms of the claim. The stop cock or valve may be considered as an element of the claim, being
99 referred to in stating the arrangement and operation of the lever.

Cross-int. 28. Do you not think that the armature, plus the projecting pin, by means of which the gas-cock is rotated and the break-piece vibrated in Complainants' Exhibit Defendants' Burner, constitutes such a lever arranged in such an organization as is contemplated by said claim?

Ans. I do not think that defendants' burner answers the terms of the said fourth claim, even when read without reference to the specification of the reissue, for the reason that the lever, even considering the armature of defendants' burner to answer the element designated as a lever in the claim, is not such a lever as is called for, because it does not open and close the stop-cock, and, further, for the reason that the circuit-breaker is not carried by the lever, as called for in said claim.

Cross-int. 29. You have no doubt that the armature vibrates the circuit-breaker, I suppose, and therefore I take your meaning to be, not that it does not move it, but that it does not carry it by being uniform with it. Is that correct?

Ans. Undoubtedly the circuit-breaker in defendants' burner is moved by the armature coming in contact with the end of the movable electrode, which is supported or carried upon the fixed electrode, and the armature impinges upon said movable electrode only at the extreme of its motion, and I cannot consider that defendants' burner is included by any proper construction, even in the terms of said fourth claim, and more especially when said claim is read by referring to the specification and drawing accompanying the same of said reissue.

Cross-int. 30. At the time of the issue of said original Tirrell patent other devices for turning on the gas in automatic electric gas-lighting apparatus were well known beside the ratchet wheel and pawl, were they not?

Ans. They were.

Cross-int. 31. And such devices had then utilized the direct action of the magnet mediately or immediately to turn on the gas, had they not?

100 Ans. If you mean by that that the magnet had operated upon its armature, and that the armature, by means of other devices than a step-by-step motion, had operated the stop-cock, I should say yes.

FRANK L. FREEMAN.

Attest: WILLIAM A. HARRIES,
Special Examiner.

Further Evidence for Complainants.

Taken pursuant to the sixty-seventh rule of the Supreme Court of the United States, in equity, as amended, before me, William E. Spear, special examiner.

BOSTON, *May* 12, 1886.

Present: Edward P. Payson, Esq., of counsel for complainants; John E. Abbott, Esq., of counsel for defendants.

Deposition of William C. Cutler.

Direct examination by EDWARD P. PAYSON, Esq., of counsel for complainants:

Int. 1. Please state your name, age, residence, and occupation.

Ans. William C. Cutler; age, forty-nine; Chelsea, Mass.; physician.

Int. 2. Were you at any time engaged directly or as the representative of any corporation in the business of electric gas-lighting? And, if yea, please state during what time, and where.

Ans. I was. Some time in 1871 or 1872 I purchased a one-third interest in a device for lighting gas by electricity, said device,
101 invented by J. P. Tirrell, afterwards constituting patent No. 130,770, and issued in 1872. Said patent was then sold to a corporation called the United States Gas Lighting Company, in which I was interested, which company was succeeded by another, to wit,

the Franklin Electric Gas Lighting Company, of which I was an officer. I think my practical connection with the business ceased about the year 1881. The business was carried on largely in Boston, in many of the suburban cities, principally in Worcester, Salem, Chelea, Mass.; also New York city.

Int. 3. Did you make any examination into patents and apparatus for electric automatic gas-lighting; and, if so, to what extent?

Ans. I did. I went to a great deal of expense—probably a thousand dollars—in the examination of all patents, caveats, and applications to be found in the United States Patent Office, occupying probably a year of time; think I was personally conversant with every patent ever issued for lighting gas by electricity prior to 1872. I was also familiar with the working of many devices and apparatus for lighting gas by electricity.

Int. 4. What apparatus did you or your company use?

Ans. For a few years our only patent used was one patented in 1872, numbered 130,770. This we applied to my own house, in Chelsea, Mass., and on a street circuit of street lamps in the same city. We used a chandelier burner shortly after 1872, under the patent No. 130,770, in Mechanics' Hall, Salem, and Mechanics' Hall, Worcester. I presume they are still in use. It was like the apparatus now shown me (Complainants' Exhibit Tirrell 1872 Chandelier Burner).

Our next burner used was a modified form of the original 1872 burner and patented in 1876, No. 184,807. These were manufactured in two different sizes—one for street-lighting purposes, another for house-work. This latter we placed in several houses in Boston, notably on Columbus avenue, Commonwealth avenue, and other parts of the South End. We also successfully lighted several houses in Worcester, in Chelsea, Newton, and other places.

For outdoor lighting we introduced it into the streets of Salem on a circuit of two miles, running it successfully from about
102 November, 1876, to June or July, 1877, at which time we received a contract for lighting the entire city. For lack of bonds to protect the city the contract was not signed by the city. No one would sign as surety, fearing interference.

The burner now shown me, marked "Complainants' Exhibit 1876 Street Burner," is the form of burner we used for street lighting, and the burner now shown me, marked "Complainants' Exhibit No. 2, 1876 Burner," is one that was used in my house five or six years successfully. In the meantime—about 1878, I think—I invented an automatic lighter, which was patented in 1879, No. 220,704. This patent was an electrical success, but was impracticable in the matter of time required for the gas to reach the breaker at the tip. It was, however, in some degree successful and was used by me for a year or two, but, owing to the above, was not so positive as desired. The burner now shown me, marked "Complainants' Exhibit Cutter Burner," is substantially the burner alluded to. It has two contact springs in place of the extension of the movable electrode I and the arm small *n* for causing the current to pass through a circuit

containing the electrodes, as shown in said patent. If I can I will produce a burner conforming exactly to the patent.

Int. 5. In comparison with the earlier patents and apparatus of which you say you made an examination is there any difference between the exhibits to which you have referred and the apparatus so examined in point of the number of electric circuits used to turn on and light the gas?

(Objected to as incompetent.)

Ans. There is a difference. There was no invention prior to our 1872 invention in which the gas was let on and ignited by one current direct in any form whatever.

Int. 6. If you know with what purpose and intention application was caused to be made by the Franklin Electric Gas Lighting Company for a reissue of letters patent No. 130,770, will you please state the same?

(Objected to as incompetent and inadmissible, the application being in writing and having been offered in evidence.)

Ans. For the reason that we were told that we had no claim
103 for the invention of the turning of the stop-cock and lighting the gas by a single current with one wire in our 1872 patent, and for no other reason.

(Answer objected to as incompetent.)

Cross-examination by JOHN E. ABBOTT, Esq., of counsel for defendants:

Cross-int. 7. Were you an officer or a stockholder of the United States Gas Lighting Company during the whole of its existence?

Ans. I was both.

Cross-int. 8. When was that company organized and when did it cease to do business?

Ans. Can't give the exact dates, but think it was organized in 1872, and think it was reorganized into another company in 1878 or 1879, and after 1879 it did no business.

Cross-int. 9. Was it that company—that is, the United States Gas Lighting Company—which put into use the burners you have referred to in your answer to the fourth direct question?

Ans. Yes; but not all of the work was done by it.

Cross-int. 10. Whom did the United States Gas Lighting Company employ to supervise the application of the burners which it put into use?

Ans. One J. H. Stevens, an electrician, of Kingston, Mass.; Frank V. Sandford, a short portion of the time, and Jacob P. Tirrell, the inventor.

Cross-int. 11. Did not that company have the said Tirrell in its employ for the purpose above referred to or for some other purpose connected with the manufacture or application of said burners during the whole or nearly the whole of the time said company carried on business?

Ans. I should say that the first four or five years the company employed him regularly; later, by odd jobs, a portion of the time.

Cross-int. 12. When and by what company were the two burners applied in the halls at Salem and Worcester, referred to in your fourth answer?

Ans. I think the Mechanics' Hall, at Worcester, was lighted
104 in 1873 or 1874, and also that at Salem in 1874 or 1875, by the United States Company or its agents.

Cross-int. 13. When was the Franklin Electric Gas Lighting Company organized and when did it cease to do business?

Ans. I can't be certain as to dates, but think it was organized in 1877 or 1878. I think it ceased to do business in 1881.

Cross-int. 14. Did that company apply any burners for automatic lighting of gas by electricity in either of the years 1880 or 1881 except for experimental use only?

Ans. My impression is that at about that time work was being done by a licensee of the company, William R. Nutting. Of this I will not be certain.

Cross-int. 15. Are you positive that said Nutting was ever a licensee of said Franklin Company?

Ans. I think he was not, but think he put in a few burners for them.

Cross-int. 16. Please state as definitely as you can the names of the owners or occupants of the houses on Columbus avenue, in Boston, and in the other places referred to in your fourth answer where said burners were applied and the dates when they were applied by any other person than by said Nutting and at any date earlier than 1880.

Ans. Frank V. Sandford put in several burners like the 1876 burner, No. 2, in a house on Commonwealth avenue, Boston, for said Franklin Company, in 1878 or 1879, but I cannot recall the name of the owner, though I visited the house. It was also put into the house of Joseph W. Bartlett, in the city of New York, about 1878; also a store on Broadway, New York, together with lights on the same street to about the number of forty, which worked successfully; also in the house of Mr. Webb, of Salem, Mass.; Charles A. Campbell, of Chelsea, Mass.; John M. Way, of Boston Highlands; in the Mechanics' Hall, of Worcester, about 1873 or 1874; also in the house of John McGee, of Chelsea, Mass., in 1877, and also in my own house and in others, whose names I cannot now recall.

Cross-int. 17. So far as you know, had there been manu-
105 factured prior to the year 1880 more than sixty burners like the burner marked "Complainants' Exhibit 1876 Burner No. 2"?

Ans. I think not, for the reason that few of them were required, not more than one or two of that kind being used in one house.

Cross-int. 18. Have you ever been a stockholder in the complainants' corporation?

Ans. I have been, but am not now.

WILLIAM C. CUTLER.

Attest: WILLIAM E. SPEAR,
Special Examiner.

Complainants put in evidence the following exhibits: Letters patent to S. Gardiner, granted Dec. 22, 1857, No. 18945, marked "Complainants' Exhibit S. Gardiner, Jr., No. 2;" a burner made under letters patent No. 29254, marked "Complainants' Exhibit Frost & Lawrence Burner;" burner made under letters patent No. 121,302, marked "Complainants' Exhibit Tirrell 1871 Burner;" burners made under letters patent No. 130,770, marked "Tirrell 1872 Burner" and "Tirrell 1872 Chandelier Burner;" burner made under letters patent No. 184,807, marked "Complainants' Exhibit 1876 Outdoor Burner," and burner marked "Tirrell 1876 Indoor Burner;" burner made under letters patent No. 206,057, marked "Complainants' Exhibit Tirrell 1878 Burner;" burner made under letters patent No. 220,704, marked "Complainants' Exhibit Cutler Burner;" two burners, marked, respectively, "Complainants' Regular Burner No. 1" and "No. 2;" also the following letters patent: No. 184,807, to J. P. Tirrell, of Nov. 28, 1876; 206,057, to J. P. Tirrell, of July 16, 1878; No. 220,704, of Oct. 21, 1879, to W. C. Cutler; No. 230,589, of July 27, 1880, to J. P. Tirrell; No. 242,222, of May 31, 1881, to G. H. Rhodes; No. 260,806, of July 11, 1882, to J. P. Tirrell, and No. 280,689, of July 3, 1883, to J. H. Gowan.

Attest: WILLIAM E. SPEAR,
Special Examiner.

106 DEFENDANTS' EXHIBIT REISSUE FILE. G. B. H., Sp'l Ex'r.

DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT OFFICE.

To all persons to whom these presents shall come, Greeting:

This is to certify that the annexed is a true copy from the files of this office of the file wrapper and contents in the matter of the reissue letters patent granted Jacob Tirrell, assignor to Franklin Electric Gas Lighting Company, June 7, 1881, No. 9743, improvement in electric apparatus for lighting street lamps, &c.

In testimony whereof I, E. M. Marble, Commissioner of Patents, have caused the seal of the Patent Office to be affixed this 29th day of June, in the year of our Lord one thousand eight hundred and eighty-three, and of the Independence of the United States the one hundred and seventh.

[SEAL.]

E. M. MARBLE,
Commissioner.

Petition.

To the Commissioner of Patents:

Your petitioner, Jacob P. Tirrell, a citizen of the United States, residing at West Somerville, in the county of Middlesex and State

of Massachusetts, prays that he may be allowed to surrender the letters patent No. 130,770, August 20, 1872, for an improvement in apparatus for lighting gas by electricity, whereof the Franklin Electric Gas Lighting Company of Boston, on whose behalf and with whose assent this application is made, is now sole owner by assignment, and that letters patent may be reissued to the aforesaid Franklin Electric Gas Lighting Company for the same invention upon the annexed amended specification.

With this petition is filed an abstract of title duly certified.

And he hereby appoints Messrs. Frost & Coe, of No. 233 Broadway, in the city of New York, and their associate in the city of Washington, his attorneys, with full power of substitution
107 and revocation, to prosecute this application, to make alterations and amendments therein, to receive the patent, to sign his name to the drawings accompanying the specification and application herein, and generally to transact all business in the Patent Office connected therewith.

JACOB P. TIRRELL.

To the Commissioner of Patents:

The undersigned, the Franklin Electric Gas Lighting Company of Boston, a corporation organized and incorporated by and under the laws of the State of Massachusetts, assignee of the entire interest in the above-mentioned letters patent, hereby assents to the accompanying application.

FRANKLIN ELECTRIC GAS LIGHTING COMPANY,
[L. S.] WM. C. CUTLER, *President.*
CHAS. F. GAY, *Treasurer.*

M. J. FUZZARD, *Witness.*
A. B. HALL.

Specification.

To all whom it may concern:

Be it known that I, Jacob P. Tirrell, a citizen of the United States, residing in West Somerville, in the county of Middlesex and State of Massachusetts, have invented certain new and useful improvements in electric apparatus for lighting street lamps, &c.; and that the following is a full, clear, and exact description of the same, reference being had to the accompanying plates of drawing.

This invention relates to that class of electrical apparatus for lighting street lamps in which the current is successively thrown into the magnet at each burner, one after another; and under this invention the circuit-breaker is located at the burner, and by the direct action of the current, through the magnet located at the burner, the circuit-breaker and the valve to let on or turn off the gas
108 are both operated, and the current, after the opening or closing, as the case may be, of the valve to one burner, is completely cut off from the magnet of such burner and thrown into the magnet of next burner, and so on.

In the accompanying plates of drawing the present invention is illustrated.

In plates 1 and 2, figures 1 and 2, are elevations from different sides. In plate 3, Fig. 3, is a partial plan view and horizontal section; Figs. 4 and 5, detailed views.

A, in the drawing, represents a gas-burner to which B is the feed pipe provided with two horizontal platforms, C and D, for carrying the apparatus of this invention; E, a U-magnet, horizontally located and secured on the lower platform C, with the pipe B, in and between the legs F of the magnet; G, the armature properly located with regard to the magnet E, and secured to the lower end of an upright lever, H, turning upon a fulcrum at I of the feed pipe B; J, the circuit-breaker, secured to the upper end of the lever H, and projecting upward to the plane of the escape of the gas from the burner; K, a post in the upper platform, D, and in electrical connection with the earth. At the upper end of the post K is a horizontal platinum arm, *b*, against which rests the point *a* of the circuit-breaker J, when the lever H is at rest. L, a spiral spring applied to lever H, to throw back the armature G from the magnet E; O, an upright arm. This arm O, at its lower end, is hung upon a fulcrum, *d*, of an insulator block, *e*, on platform C, and at its upper end it is in a position to bear against the periphery of a sector wheel, *f*, fixed to the spindle *g* of valve in gas-pipe B; *c*, a bent spring applied to arm O to hold it against the sector wheel *f*, and when escaping from the periphery thereof to swing it on its fulcrum. The arm O at P, between its two ends, is insulated; *h*, a finger piece projecting horizontally from lower end of arm O. This finger piece *h*, at its outer end, lies in a position between the two pins, *l* and *m*, projecting horizontally, one above the other, from the block *e*. The lower pin, *l*, extends wholly through the block *e*, and similarly projects therefrom from its other side, being there lettered as l^2. The upper pin, *m*, only enters the block, but on the opposite side of the block thereto a similar pin, m^2, is located, also only entering the block. Q is an arm similarly constructed, arranged and hung on the block *e* to the arm O. This arm Q is in position to bear upon the periphery of a sector wheel, *n*, fixed to the gas-valve spindle *g* and for its finger-piece h^2 to lie in and between the projecting pins l^2 and m^2 of the block *e*. The sector wheel *n* is back of the sector wheel *f*. The two sector wheels, *f* and *n*, are of equal diameter and of an equal length of arc—that is, a half of a circle; the two together complete the circumference. The relative location of the sector wheels *f* and *n* on the valve spindle is such that with the arm O on the periphery of the sector wheel *f* the arm Q will be off the periphery of its sector wheel *n*, and *vice versa;* and the purpose of the said sector wheels is to turn their respective arms O Q, so as to bring about a bearing between their respective finger pieces *h* h^2 and the lower pins *l* l^2, and also to allow the springs applied to the said arms O Q to react and bring their finger pieces into contact with the upper pins *m* m^2. R is a ratchet wheel secured to gas-valve spindle back of inner sector-wheel *n*, and S a spring pawl hung to lever H, and arranged from the movement of such lever to

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act upon the ratchet wheel R to turn it in the direction of the arrow, Fig. 1, plate 1. In lieu of a ratchet wheel a friction wheel and clutch may be employed, such as shown in Fig. 5. M and N are wires leading from the electric battery employed; the wire M is to let on and the wire N to shut off the gas at the burner A. The current is thrown into the one or the other of said wires by means of a double switch, such as is employed ordinarily in electrical gas-lighting apparatus, and therefore needs no particular description herein.

The wire M connects with the arm O and the wire N with the arm Q. T is a wire connecting lower pin *l* with magnet E, and U a wire connecting magnet with circuit-breaker J. V and W are wires respectively connected with upper pins *m* and m^2, from which they are to lead to the next burner, and to such burner become the letting-on and turning-off wires, as the wire M and N to the burner A.

The position of the several parts composing the mechanism hereinabove described is at all times, if at rest, substantially that shown in Fig. 1, plate 1, and only differs therefrom in any condition of rest in the relative positions of the two arms, O Q, according as one or the other is bearing on its respective sector wheel, *f* or *n*. By the shown positions of the two arms, O and Q, the finger piece *h* of the arm O is against the lower pin *l* and the finger piece h^2 of arm Q against the upper pin m^2 of block *e*. This relative contact with the pins *l* l^2 *m* m^2 of the finger pieces to the two arms is always maintained, they never being both at the same time in contact with the lower pins *l* l^2 or the upper pins *m* m^2, but always the one with a lower pin and the other with an upper pin alternately.

If, now, with the arms O and Q in the relative positions described and shown, a current of electricity be thrown into the wire M (which, as stated, is the letting-on wire), it is obvious it will pass into the magnet (the connection being through arm O, finger piece *h*, pin *l*, and wire T), thence to the circuit-breaker J; and then, as the circuit is complete, the armature G will be drawn toward the magnet, turning its lever H on its fulcrum, which carries the circuit-breaker J beyond the end of the platinum arm *b*, breaking thereby the circuit and emitting an electric spark. This breaking of the circuit destroys the attractive force of the magnet and leaves the lever H to be pulled backward by the spring L, which backward movement of the lever completes the circuit by bringing the circuit-breaker into contact with the platinum arm *b*, when another attraction of the armature G occurs, again breaking the circuit emitting a spark, and so on as before.

By this alternate forward and backward movement of the lever H the ratchet wheel R on gas-valve spindle is intermittently rotated, carrying with it the valve spindle *g* and sector wheels *f n*. If this rotation of the valve spindle *g* be continued sufficiently the periphery of the sector wheel *f* will be carried beyond the arm O, leaving it free for its spring to act upon it, and thus to throw its finger piece *h* out of contact with the lower pin *l* and into contact with the upper pin *m*, and the periphery of the sector wheel *n* will be brought to

bear upon the arm Q, throwing its finger piece h^2 out of contact with the upper pin m^2 and into contact with the lower pin l^2.

With the movement of the sector wheel *f* beyond its arm O and of the sector wheel *n* onto its arm Q, as above described, results have been effected as follows: First, the gas-valve or stop-cock has been opened to its fullest extent, and as, at each stroke of lever H
111 caused by the successive attraction of the armature, the circuit was broken and a spark emitted, it is obvious that the gas necessarily must have been lighted. Second, the current of electricity through wire M is cut off from the magnet E and thrown into the wire V leading to the magnet of the next burner, and which, as before stated, is the letting-on wire to such burner. Third, a connection has been established between the magnet E and the shutting-off wire N, so that when desired to shut off the gas from the burner A the operator has only to make the necessary connection between battery and shutting-off wire.

The connection between shutting-off wire N and the magnet is through arm Q, its finger piece h^2, pin l^2, and wire T.

In shutting off the gas at the burner the operation of the parts is precisely similar to the letting on of the gas, and therefore needs no particular description; and on its completion the arm Q escapes from its sector wheel *n*, and the arm O passes on to its sector wheel *f*, re-establishing the connection between letting-on wire and magnet as before. Completing the shutting off of the gas at one burner throws the current into the wire W, leading from such burner A to the next burner, which wire W to the said next burner is the shutting-off wire.

In figure 4 the valve in gas-pipe is shown in detail and is such that in a half turn of the spindle *g* the gas will be let on, and, continuing the turn, shut off.

The location of the circuit-breaker at the gas-burner is such that as it breaks the circuit by escaping from the platinum arm *b* the spark emitted will be sufficiently near to the escaping gas to ignite the same, and it is desirable that the movement to let on the gas should be so divided as to emit a sufficient number of sparks to insure the lighting of the gas.

I do not claim turning on and off the gas by means of a step-by-step motion, as such is not my invention.

Having thus described my invention, what I claim is as follows:

1st. In an apparatus for lighting gas by electricity, a wire through which a current of electricity is passed, having electrical connection with an electro-magnet attracting an armature, which armature actuates mechanism operating automatically to
112 turn on the gas and light the same by an electric spark or sparks at the tip of the gas-burner.

2d. In an apparatus for lighting gas by electricity, a wire through which a current of electricity is passed, having electrical

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connections with an electro-magnet attracting an armature, which armature actuates mechanism operating automatically to turn off the gas and extinguish the light.

3d. In an apparatus for lighting gas by electricity, two wires through which currents of electricity are passed, each wire electrically connected with the same electro-magnet, attracting an armature, which armature actuates mechanism operating automatically to turn on the gas and light the same by an electric spark or sparks at the tip of the gas-burner, and also to turn off the gas and extinguish the light.

4th. In an apparatus for lighting gas by electricity, two wires through which currents of electricity are passed, which wires are electrically connected with an electro-magnet, attracting an armature, which armature actuates mechanism operating automatically to turn on the gas and light the same by an electric spark or sparks at the tip of the gas-burner, and also to turn off the gas and extinguish the light.

2 5th. In apparatus for lighting gas by electricity, a circuit-breaker located at the burner and operated automatically, substantially as described.

2 [3] [6th].* In an apparatus for lighting gas by electricity, the helix of an electro-magnet connected at one end with the wire through which the current of electricity is passed, and at the other end with a circuit-breaker located at the gas-burner, so arranged that the current of electricity is passed to the circuit-breaker through said magnet, attracting an armature-actuating mechanism, operating automatically to turn on the gas and light the same by the effects of the primary sparks made at the tip of the burner from said magnet in the circuit.

3 [4]* 7th. The arms O Q, sector wheel f n, pins l l^2, m m^2, wires M^m N^n, magnet E, lever H, carrying armature G, circuit-breaker J, and pawl S, and the ratchet wheel, all combined and arranged together and applied to a gas-burner for operation substantially as and for the purposes set forth.

113 4 [5] [8th].* In an apparatus for lighting gas by electricity in combination with a circuit-breaker located at the gas-burner, a lever adapted and arranged to open and close the stop cock or valve of the burner and carrying the circuit-breaker, substantially as herein described.

5 [6] [9th].* In an apparatus for lighting gas by electricity, the combination of a wire, through which a current of electricity is passed actuating mechanism for letting on the gas, an electro-magnet electrically connected with said wire, an armature operated by said electro-magnet, mechanism actuated by said armature breaking the circuit at the burner tip and producing there an electric spark or sparks [from the effects of the electro-magnet]* for lighting gas, the whole operating automatically.

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* Words and figures enclosed in brackets erased in copy.

10th. In an apparatus for lighting gas by electricity, the combination of two wires through which currents of electricity are passed, actuating mechanism for both letting on and turning off the gas by substantially the same means, an electro-magnet electrically connected with said wires, an armature operated by said electro-magnet, mechanism actuated by said armature for breaking the circuit at the burner tip and producing there the primary or electric spark or sparks for lighting the gas, mechanism actuated by said armature for turning off the gas, the whole operated automatically.

11th. In an apparatus for lighting gas by electricity, a series of electro-magnets connected with a series of gas-burners, so arranged that when a current of electricity is passed through a wire-actuating mechanism for letting on the gas of the first burner to an electro-magnet connected therewith said magnet operates an armature-actuating mechanism operating automatically to turn on the gas of the first burner and light the same by an electric spark or sparks at the tip of the burner, and also to cut off the current of electricity from the first electro-magnet and throw the same into the wire-actuating mechanism for letting on the gas of the next burner.

In testimony whereof I have hereunto set my hand this eleventh day of February, A. D. 1881.

JACOB P. TIRRELL.

In presence of—
A. B. HALL.
CHAS. F. GAY.

114 *Oath.*

STATE OF MASSACHUSETTS, *County of Suffolk,* } *ss:*

Jacob P. Tirrell, the above-named petitioner, being duly sworn, deposes and says that he verily believes that his aforesaid letters patent are inoperative by reason of a defective specification, and that such defect consists in the omission of claims for the different combinations of wires, electro-magnets, armature attracted thereby, mechanism actuated by said armature, circuit-breaker, and other elements operating automatically as specified and claimed in the claims of this application.

And that the error arose by inadvertence, accident, or mistake without any fraudulent or deceptive intent.

That the Franklin Electric Gas Lighting Company of Boston is the sole owner of said letters patent, and that this application is made on the behalf of and with the consent of the said Franklin Electric Gas Lighting Company.

Words and sentences enclosed between rules erased in copy.

And that he verily believes himself to be the first and original inventor of the improvement set forth and claimed in this amended specification, and he does not believe that the same was ever before known or used.

Sworn to and subscribed before me this eleventh day of February, 1881.

JACOB P. TIRRELL.

SUFFOLK, *ss:*

Then personally appeared the above-named Jacob P. Tirrell, who made oath and subscribed to the above instrument before me—

STILLMAN P. MARCH,
Justice of the Peace.

115 Room No. 91.

DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT OFFICE,
WASHINGTON, D. C., *March 8th*, 1881.

Jacob P. Tirrell, cr. Frost & Coe, 233 Broadway, New York city.

Apparatus for lighting gas by electricity. (Filed Feb. 21, 1881.)

$\frac{26728}{35}$

Reissue of No. 130,770.

The 1st, 2d, 3d, 4th, 5th, 10th, and 11th claims are met by applicant's former patent, No. 121,301, Nov. 28, 1871 (gas-lighting).

The fourth claim is bad in form; it would be better to put the elements in direct combination.

The 7th and 8th lines on page 15 are not understood.

The case is accordingly rejected.

F. L. FREEMAN, *Examiner.*

K., *3d Ass't.*

Reissue Application.

Room 91.

J. P. Tirrell, electric gas-lighting apparatus. (Filed Feb. 17, 1881.)

To the Commissioner of Patents:

I hereby amend the above case as follows:

Erase the words "if now" in line 21, page 7. Insert the words "if now" before the word "with," line 19, same page.

Erase claims 1, 2, 3, 4, 10, and 11. Insert the following claim and adjust the numerals of the remaining claims.

1. In an apparatus for lighting gas by electricity, the combination of two wires through which currents of electricity are
116 passed, an electro magnet or magnets electrically connected therewith, an armature or armatures attached by said magnet or magnets, and mechanism actuated by said armature or armatures and operating automatically, whereby the gas is turned on and lighted by an electric spark or sparks at the tip of the gas-burner and the gas also turned off and the light extinguished, substantially as described.

Erase the words "from the effects of the electro-magnet" in claim 9, on page 15.

Insert the following claim:

6th [7th]*. In an apparatus for lighting gas by electricity, the combination of two wires through which currents of electricity are passed, actuating mechanism for both letting on and turning off the gas by substantially the same means, an electro-magnet electrically connected with said wires, an armature operated by said electro-magnet, mechanism actuated by said armature for breaking the circuit at the burner tip and producing there the spark or sparks for lighting the gas, the whole operating automatically, substantially as described.

A reconsideration of claim 2, formerly claim 5, is respectfully requested, as it is almost identically the same as claim 1 of the original patent.

In the former patent of applicant's cited as a reference by the examiner the gas is first lighted at an auxiliary burner whose flame ignites the gas at the illuminating burner.

In the present application the circuit-breaker is located directly at the illuminating burner, no auxiliary burner being used.

It is believed that the claims as now presented do not conflict with the reference, and a favorable action on the case is therefore respectfully requested.

J. P. TIRRELL,
Per FROST & COE, *Attorneys.*

Washington, D. C., March 30, 1881.

Words and sentences enclosed between rules erased in copy.
*Figure enclosed in brackets erased in copy.

117 Room No. 91.

DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT OFFICE,
WASHINGTON, D. C., *April 5th*, 1881.

Jacob P. Tirrell, cr. Frost & Coe, 233 Broadway, New York city.

Apparatus for lighting gas by electricity. (Filed Feb. 21, 1881.)

$\frac{26728}{35}$

This case has been again examined. There being but a single magnet and a single armature shown, applicant cannot pluralize these terms as he has done in his amended first claim.

The 1st and 7th claims inserted by amendment March 27, as well as the third (original sixth) claim, are met by Edward E. Bean, 90629, June 1, 1869 (gas-lighting).

The 2d (original 5th) claim is met by Morris and Reid, 101,491, April 18, '70 (gas-lighting).

K. F. L. FREEMAN, *Examiner.*

Reissue Application.

Room 91.

J. P. Tirrell, lighting gas by electricity. (Filed Feb. 21, 1881.)

To the Commissioner of Patents:

I hereby amend the above case as follows:

Erase claims 1 and 2 and insert the following claims:

1. In an apparatus for lighting gas by electricity, the combination of two wires through which currents of electricity are passed, an electro-magnet electrically connected therewith and attracting an armature which actuates mechanism substantially as described for automatically turning on the gas and lighting the same by an electric spark at the tip of the gas-burner, and also for turning off the gas to extinguish the light, substantially as described.

118 2. In an apparatus for lighting gas by electricity, a circuit-breaker located at the top of the burner and operated automatically by means substantially as described.

A favorable consideration of claims 1 and 2 as now presented and a favorable reconsideration of claims 3 and 7 is respectfully requested, for the reasons that the reference cited for said claims does not show a circuit-breaker located at the burner.

A speedy action is respectfully requested.

J. P. TIRRELL,
Per FROST & COE, *Attorneys.*

Washington, D. C., April 29, 1881.

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Room No. 91.

DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT OFFICE,
WASHINGTON, D. C., *April* 30, 1881.

Jacob P. Tirrell, cr. Frost & Coe, 233 Broadway, New York city.

Apparatus for lighting gas by electricity. (Filed Feb. 21, 1881.)

$\frac{20728}{35}$

This case has received further attention.

The present second claim is substantially the same as the original 5th, and is met by Morris and Reid, 101,491, April 5, 1870 (gas lighting).

F. L. FREEMAN, *Examiner.*

KNIGHT, 3*d Ass't.*

Reissue Application.

Room 91.

J. P. Tirrell. Apparatus for lighting gas by electricity. (Filed Feb. 17, 1881.)

To the Commissioner of Patents:

I hereby amend the above application by erasing claim 2 and adjusting the numerals of the remaining claims.

The application having been amended in conformity with
119 the requirements of the office, and being a reissue application, an immediate allowance is respectfully requested.

J. P. TIRRELL,
Per FROST & CO., *Attorneys.*

DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT OFFICE,
WASHINGTON, D. C., *May* 18, 1881.

Jacob P. Tirrell, ass'or, per Frost & Coe, No. 233 Broadway, New York.

SIR: Your application for reissue of patent No. 130,770 for improvement in electrical apparatus for lighting street lamps, &c., has been examined and allowed.

The patent will be forwarded to you as soon as practicable in due order of business.

Very respectfully,

E. M. MARBLE,
Commissioner of Patents.

Serial No. 26728. Ex'r Book No. 35. 1881. Div. 16.
FREEMAN.

Reissue.

No. 9743.

J. P. Tirrell, ass'or by mesne ass'ts to Franklin Electric Gas Lighting Company of Boston, Mass., of West Somerville, county of Middlesex, State of Massachusetts. Invention: Apparatus for lighting gas by electricity.

Parts of application filed.
- Petition, Feb. 17, 1881.
- Affidavit, " " "
- Specification, " " "
- Drawing, 3 sheets, " " "
- Model.
- Old patent, No. 130,770, Aug. 20, 1872.
- Cert. dep., $30, Feb. 17, 1881.

120 Cash.

Abstract of title, Feb. 21, 1881.
Application filed complete, Feb. 21, 1881.
2. Examined May 16, 1881. Freeman.
Countersigned May 17, 1881. J. W. Babson, for Commissioner.
Notice of allowance, May 18, 1881.
Patented Aug. 20, 1872.
3. Reissued June 7, 1881.
Reissued.

FROST & COE, *Attorneys.*

Or P. O. address,
223 Broadway,
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Application Papers.

1. March 8, 1881, rejected.
2. March 27, 1881, admt. "A B."
3. April 4, 1881, rejected.
4. April 29, 1881, admt. "C D."
5. April 30, 1881, rejected.
6. May 11, 1881, amendment.
7. May 16, 1881, brief.

Title: Improvement in electrical apparatus for lighting street lamps, &c.

36, electricity.
Gas lighting.

(The file ends with Patent Office printed copies of the specifications and drawings of the reissue.)

125

3 Sheets—Sheet 3.

J. P. TIRRELL,

Assignor, by mesne assignments, to FRANKLIN ELECTRIC GAS LIGHTING CO.

Electrical Apparatus for Lighting Street Lamps, &c.

No. 9,743. **Reissued June 7, 1881.**

Fig. 4.

Fig. 5.

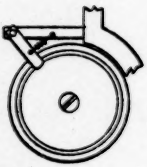
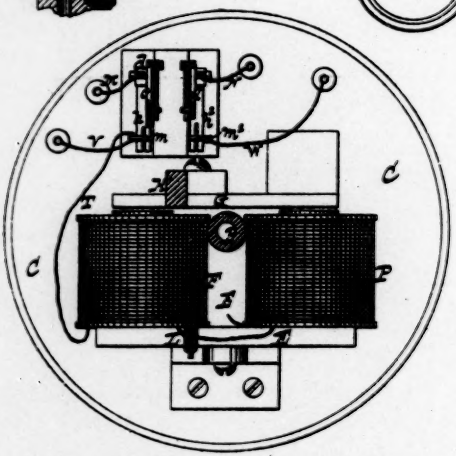


Fig. 3.



No 232. Electric Gas Lighting Co. vs Boston Electric Co. p. 125

Witnesses.
R. D. Van Rostereck
E. C. Simonson

Inventor
Jacob P. Tirrell
per
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Attorneys

3 Sheets—Sheet 2.

J. P. TIRRELL,

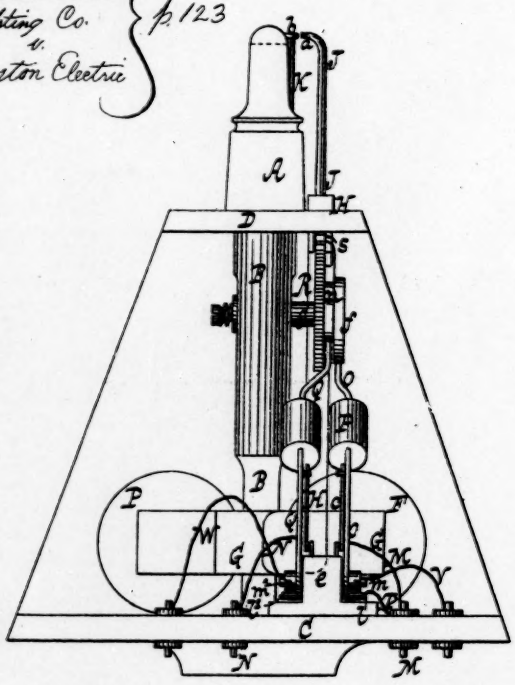
Assignor, by mesne assignments, to FRANKLIN ELECTRIC GAS LIGHTING CO.

Electrical Apparatus for Lighting Street Lamps, &c.

No. 9,743. **Reissued June 7, 1881.**

No 232. Electric Gas Lighting Co. v. Boston Electric Co. } p. 123

Fig. 2.



Witnesses.
R. J. Van Rosbercke
E. C. Simonson

Inventor.
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Dyer & Coe
Attorneys

3 Sheets—Sheet 1.

J. P. TIRRELL,

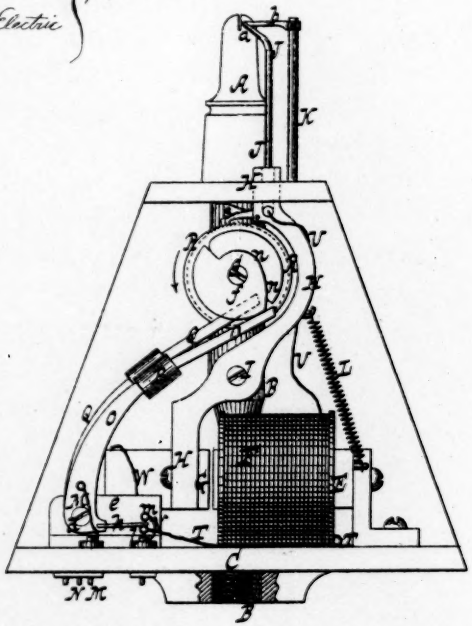
Assignor, by mesne assignments, to FRANKLIN ELECTRIC GAS LIGHTING CO.

Electrical Apparatus for Lighting Street Lamps, &c.

No. 9,743. **Reissued June 7, 1881.**

No. 232.
Electric Gas Lighting Co.
v.
Boston Electric Co.
} p. 121

Fig. 1.



Witnesses.
R. F. Van Voskerck
E. C. Simonson

Inventor
Jacob P. Tirrell
per
Frost & Coe
Attorneys

126 UNITED STATES PATENT OFFICE.

JACOB P. TIRRELL, of West Somerville, assignor, by mesne assignments, to Franklin Electric Gas Lighting Company, of Boston, Massachusetts.

Electrical Apparatus for Lighting Street-Lamps, &c.

Specification forming part of Reissued Letters Patent No. 9743, dated June 7, 1881; original No. 130,770, dated August 20, 1872; application for reissue filed February 21, 1881.

To all whom it may concern:

Be it known that I, Jacob P. Tirrell, a citizen of the United States, residing in West Somerville, in the county of Middlesex and State of Massachusetts, have invented certain new and useful improvements in electrical apparatus for lighting street-lamps, &c., and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying plates of drawings.

This invention relates to that class of electrical apparatus for lighting street-lamps in which the current is successively thrown into the magnet at each burner one after another; and under this invention the circuit-breaker is located at the burner, and, by the direct action of the current through the magnet located at the burner, the circuit-breaker and the valve to let on or turn off the gas are both operated, and the current, after the opening or closing, as the case may be, of the valve to one burner, is completely cut off from the magnet of such burner and thrown into the magnet of next burner, and so on.

In the accompanying plates of drawings the present invention is illustrated.

(Here follow diagrams marked pp. 121, 123, & 125.)

In plates 1 and 2, figures 1 and 2 are elevations from different sides. In plate 3, Fig. 3 is a partial plan view and horizontal section; Figs. 4 and 5, detailed views.

A in the drawings represents a gas-burner, to which B is the feed-pipe provided with two horizontal platforms, C and D, for carrying the apparatus of this invention; E, a U-magnet, horizontally located and secured on the lower platform, C, with the pipe B in and between the legs F of the magnet; G, the armature, properly located with regard to the magnet E and secured to the lower end of an upright lever, H, turning upon a fulcrum at I of the feed-pipe B; J, the circuit-breaker, secured to the upper end of the lever H and projecting upward to the plane of the escape of the gas from the burner; K, a post in upper platform, D, and in electrical connection with the earth.

At the upper end of the post K is a horizontal platinum arm, *b*,

against which rests the point *a* of the circuit-breaker J when the lever H is at rest; L, a spiral spring applied to lever H, to throw back the armature G from the magnet E; O an upright arm. This arm O, at its lower end, is hung upon a fulcrum, *d*, of an insulator block, *e*, on platform C, and at its upper end it is in a position to bear against the periphery of a sector-wheel, *f*, fixed to the spindle *g* of valve in gas-pipe B; *c*, a bent spring applied to arm O to hold it against the sector-wheel *f*, and, when escaping from the periphery thereof, to swing it on its fulcrum. The arm O at P, between its two ends, is insulated.

h is a finger-piece projecting horizontally from lower end of arm O. This finger-piece *h*, at its outer end, lies in a position between the two pins *l* and *m*, projecting horizontally one above the other from the block *e*. The lower pin, *l*, extends wholly through the block *e*, and similarly projects therefrom from its other side, being there lettered as l^2. The upper pin, *m*, only enters the block; but on the opposite side of the block thereto a similar pin, m^2, is located, also only entering the block.

Q is an arm similarly constructed, arranged, and hung on the block *e* to the arm O. This arm Q is in position to bear upon the periphery of a sector-wheel, *n*, fixed to the gas-valve spindle *g*, and for its finger-piece h^2 to lie in and between the projecting pins l^2 and m^2 of the block *e*. The sector-wheel *n* is back of the sector-wheel *f*. The two sector-wheels *f* and *n* are of equal diameter, of an equal length of arc, that is, a half of a circle. The two together complete the circumference. The relative location of the sector-wheels *f* and *n* on the valve-spindle is such that with the arm O on the periphery of the sector-wheel *f* the arm Q will be off the periphery of its sector-wheel *n* and vice versa, and the purpose of the said sector-wheels is to turn their respective arms O Q, so as to bring about a bearing between their respective finger-pieces *h* h^2 and the lower pins, *l* l^2, and also to allow the springs applied to the said arms O Q to react and bring their finger-pieces into contact with the upper pins, *m* m^2.

R is a ratchet-wheel secured to gas-valve spindle back of in-
127 ner sector-wheel, *n*; and S a spring-pawl hung to lever H, and arranged from the movement of such lever to act upon the ratchet-wheel R to turn it in the direction of the arrow, Fig. 1, plate 1. In lieu of a ratchet-wheel, a friction wheel and clutch may be employed, such as shown in Fig. 5.

M and N are wires leading from the electric battery employed. The wire M is to let on, and the wire N to shut off, the gas at the burner A. The current is thrown into the one or the other of said wires by means of a double switch, such as is employed ordinarily in electrical gas-lighting apparatus, and therefore needs no particular description herein. The wire M connects with the arm O, and the wire N with the arm Q.

T is a wire connecting lower pin, *l*, with magnet E, and U a wire connecting magnet with circuit-breaker J.

V and W are wires respectively connected with upper pins, *m* and m^2, from which they are to lead to the next burner, and to

such burner become the letting-on and turning-off wires, as the wires M and N to the burner A.

The position of the several parts composing the mechanism hereinabove described is at all times, if at rest, substantially that shown in Fig. 1, plate 1, and only differs therefrom in any condition of rest in the relative positions of the two arms O Q, according as one or the other is bearing on its respective sector-wheel, *f* or *n*. By the shown positions of the two arms O and Q the finger-piece *h* of the arm O is against the lower pin, *l*, and the finger-piece h^2 of arm Q against the upper pin, m^2, of block *e*. This relative contact with the pins *l* l^2 *m* m^2 of the finger-pieces to the two arms is always maintained, they never being both at the same time in contact with the lower pins, *l* l^2, or the upper pins, *m* m^2, but always the one with a lower pin and the other with an upper pin alternately. If, now, with the arms O and Q in the relative positions described and shown, a current of electricity be thrown into the wire M (which, as stated, is the letting-on wire) it is obvious it will pass into the magnet (the connection being through arm O, finger-piece *h*, pin *l*, and wire T), thence to the circuit-breaker J; and then, as the circuit is complete, the armature G will be drawn toward the magnet, turning its lever H on its fulcrum, which carries the circuit-breaker J beyond the end of the platinum arm *b*, breaking thereby the circuit and emitting an electric spark. This breaking of the circuit destroys the attractive force of the magnet, and leaves the lever H to be pulled backward by the spring L, which backward movement of the lever completes the circuit by bringing the circuit-breaker into contact with the platinum arm *b*, when another attraction of the armature G occurs, again breaking the circuit, emitting a spark, and so on, as before. By this alternate forward and backward movement of the lever H the ratchet-wheel R on gas-valve spindle is intermittently rotated, carrying with it the valve-spindle *g* and sector-wheels *f n*. If this rotation of the valve-spindle *g* be continued sufficiently, the periphery of the sector-wheel *f* will be carried beyond the arm O, leaving it free for its spring to act upon it, and thus to throw its finger-piece *h* out of contact with the lower pin, *l*, and into contact with the upper pin, *m*, and the periphery of the sector-wheel *n* will be brought to bear upon the arm Q, throwing its finger-piece h^2 out of contact with the upper pin, m^2, and into contact with the lower pin, l^2.

With the movement of the sector-wheel *f* beyond its arm O and of the sector-wheel *n* onto its arm Q, as above described, results have been effected as follows: First, the gas-valve or stop-cock has been opened to its fullest extent, and as at each stroke of the lever H caused by the successive attraction of the armature the circuit was broken and a spark emitted, it is obvious that the gas necessarily must have been lighted; second, the current of electricity through wire M is cut off from the magnet E and thrown into the wire V leading to the magnet of the next burner, and which, as before stated, is the letting-on wire to such burner; third, a connection has been established between the magnet E and the shutting-off wire N, so that when desired to shut off the gas from the burner A the

operator has only to make the necessary connection between battery and shutting-off wire. The connection between the shutting-off wire N and the magnet is through arm Q, its finger-piece h^2, pin l^2, and wire T.

In shutting off the gas at the burner the operation of the parts is precisely similar to the letting on of the gas, and therefore needs no particular description; and on its completion the arm Q escapes from its sector-wheel *n*, and the arm O passes onto its sector-wheel *f*, re-establishing the connection between letting-on wire and magnet, as before. Completing the shutting off of the gas at one burner throws the current into the wire W leading from such burner A to the next burner, which wire W to the said next burner is the shutting-off wire.

In Fig. 4 the valve in gas-pipe is shown in detail, and is such that in a half-turn of the spindle *g* the gas will be let on, and, continuing the turn, shut off.

The location of the circuit-breaker at the gas-burner is such that as it breaks the circuit by escaping from the platinum arm *b* the spark emitted will be sufficiently near to the escaping gas to ignite the same, and it is desirable that the movement to let on the gas should be so divided as to emit a sufficient number of sparks to insure the lighting of the gas.

I do not claim turning on and off the gas by means of a step-by-step motion, as such is not my invention.

Having thus described my invention, what I claim is as follows:

1. In an apparatus for lighting gas by electricity, the com-
128 bination of two wires through which currents of electricity are passed, an electro-magnet electrically connected therewith and attracting an armature which actuates mechanism, substantially as described, for automatically turning on the gas and lighting the same by an electric spark at the tip of the gas-burner, and also for turning off the gas to extinguish the light, substantially as described.

2. In an apparatus for lighting gas by electricity, the helix of an electro-magnet connected at one end with the wire through which the current of electricity is passed, and at the other end with a circuit breaker located at the gas-burner, so arranged that the current of electricity is passed to the circuit-breaker through said magnet, attracting an armature-actuating mechanism operating automatically to turn on the gas and light the same by the effects of the primary sparks made at the tip of the burner from said magnet in the circuit.

3. The arms O Q, sector-wheel *f n*, pins *l* l^2 *m* m^2, wires M N, magnet E, lever H, carrying armature G, circuit-breaker J, and pawl S, and the ratchet-wheel, all combined and arranged together and applied to a gas-burner for operation, substantially as and for the purposes set forth.

4. In an apparatus for lighting gas by electricity, in combination with a circuit-breaker located at the gas-burner, a lever adapted and arranged to open and close the stop-cock or valve of the burner, and carrying the circuit-breaker, substantially as herein described.

3 Sheets--Sheet 3.

J. P. TIRRELL.

Improvement in Apparatus for Lighting Gas by Electricity.

No. 130,770. Patented Aug. 20, 1872.

No. 232. Electric Gas Lighting & Boston Electric Co. } p. 135

FIG. 4.

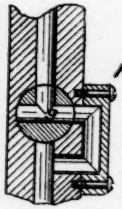


FIG. 5.

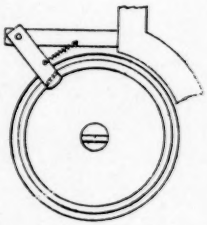
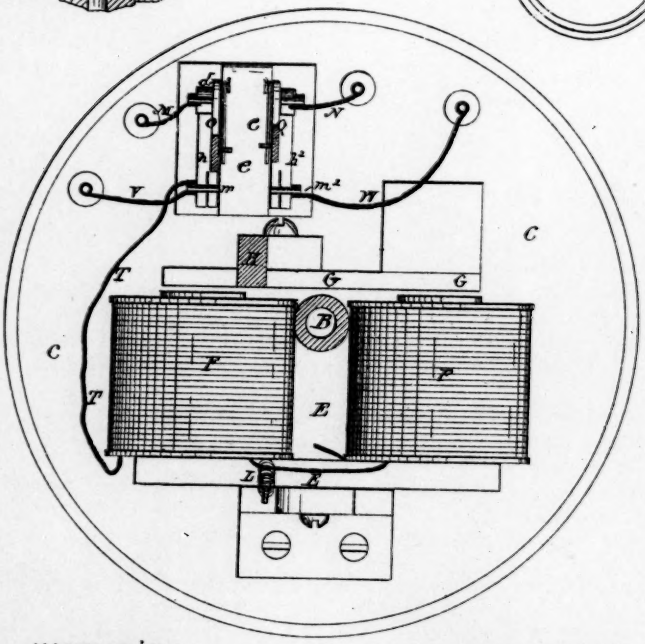


FIG. 3.



WITNESSES.

C. A. Pease
J. P. McElroy

INVENTOR.

Jacob P. Tirrell per
Brown Brothers
Attorneys.

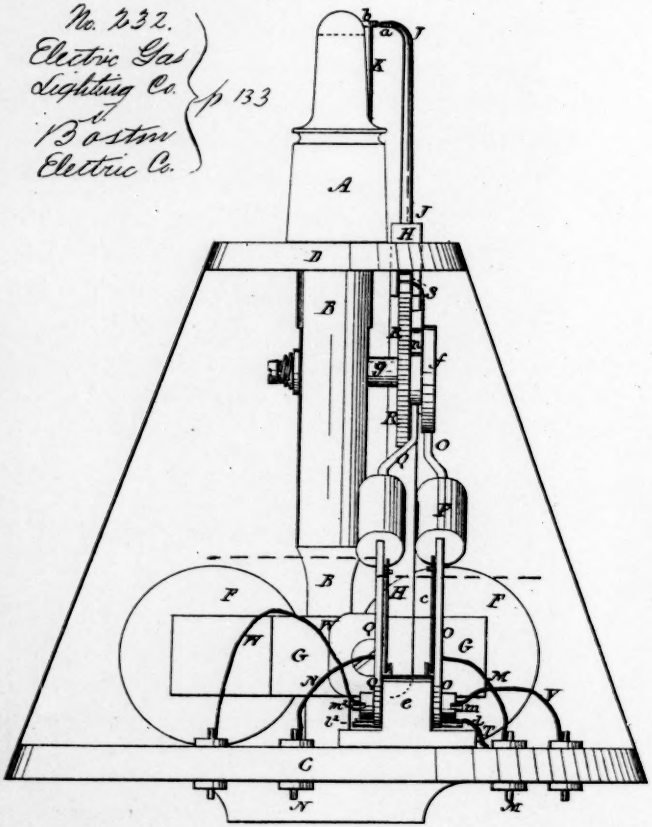
3 Sheets--Sheet 2.

J. P. TIRRELL.

Improvement in Apparatus for Lighting Gas by Electricity.

No. 130,770. FIG. 2. Patented Aug. 20, 1872.

No. 232.
Electric Gas
Lighting Co.
v.
Boston
Electric Co.
} p 133



WITNESSES.

C. J. Tease
J. P. McElroy

INVENTOR.

Jacob P. Tirrell
per
Brown Brothers
Attorneys.

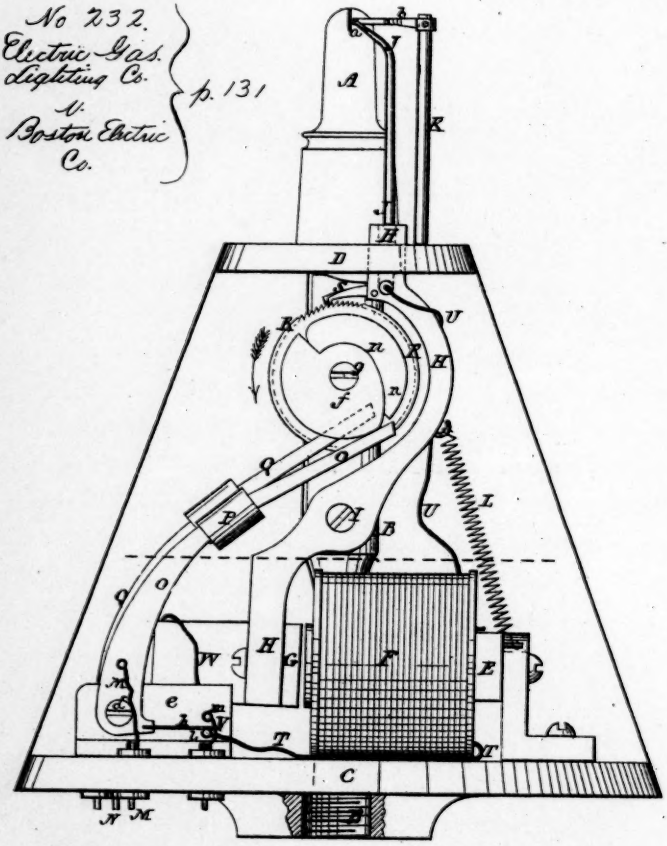
3 Sheets--Sheet 1.

J. P. TIRRELL.

Improvement in Apparatus for Lighting Gas by Electricity.

No. 130,770. FIG. 1. Patented Aug. 20, 1872.

No 232.
Electric Gas Lighting Co.
v.
Boston Electric Co.
p. 131



WITNESSES.

C. A. Pease
J. P. McElroy

INVENTOR.

Jacob P. Tirrell
per
Brown Brothers
Attorneys.

5. In an apparatus for lighting gas by electricity, the combination of a wire through which a current of electricity is passed, actuating mechanism for letting on the gas, an electro-magnet electrically connected with said wire, an armature operated by said electro-magnet, mechanism actuated by said armature, breaking the circuit at the burner-tip, and producing there an electric spark or sparks for lighting the gas, the whole operating automatically.

6. In an apparatus for lighting gas by electricity, the combination of two wires through which currents of electricity are passed, actuating mechanism for both letting on and turning off the gas by substantially the same means, an electro-magnet electrically connected with said wires, an armature operated by said electro-magnet, mechanism actuated by said armature for breaking the circuit at the burner-tip, and producing there the spark or sparks for lighting the gas, the whole operating automatically, substantially as described.

In witness whereof I have hereunto set my hand this 11th day of February, A. D. 1881.

JACOB P. TIRRELL.

In presence of—
A. B. HALL.
CHAS. T. GAY.

136 UNITED STATES PATENT OFFICE.

JACOB P. TIRRELL, of Charlestown, Massachusetts.

Improvement in Apparatus for Lighting Gas by Electricity.

Specification forming part of Letters Patent No. 130,770, dated August 20, 1872.

To all whom it may concern:

Be it known that I, Jacob P. Tirrell, of Charlestown, in the county of Middlesex and State of Massachusetts, have invented certain new and useful improvements in electrical apparatus for lighting street-lamps, &c.; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying plates of drawings.

This invention relates to that class of electrical apparatus for lighting street-lamps, in which the current is successively thrown into the magnet at each burner one after another, and under this invention the circuit-breaker is located at the burner, and by the direct action of the current through the magnet located at the burner the circuit-breaker and the valve to let on or turn off the gas are both operated, and the current, after the opening or closing, as the case may be, of the valve to one burner is completely cut off from the magnet of such burner and thrown into the magnet of the next burner, and so on.

In the accompanying plates of drawings the present invention is illustrated.

(Here follow diagrams marked pp. 131, 133, and 135.)

In plates 1 and 2, figures 1 and 2, are elevations from different sides. In plate 3 Fig. 3 is a partial plan view and horizontal section; Figs. 4 and 5, detail views.

A in the drawings represents a gas-burner, to which B is the feed-pipe, provided with two horizontal platforms, C and D, for carrying the apparatus of this invention.

E is a U-magnet, horizontally located, and secured on the lower platform, C, with the pipe B in and between the legs F of the magnet.

G is the armature, properly located with regard to the magnet E, and secured to the lower end of an upright lever, H, turning upon a fulcrum at I of the feed-pipe B.

J is the circuit-breaker, secured in the upper end of the lever H and projecting upward to the plane of escape of the gas from the burner; K, a post in upper platform, D, and in electrical connection with the earth. At the upper end of the post K is a horizontal platinum arm, *b*, against which rests the point *a* of the circuit-breaker J when the lever H is at rest.

L is a spiral spring, applied to lever H to throw back the armature G from the magnet E.

O is an upright arm. This arm O at its lower end is hung upon a fulcrum, *d*, of an insulator block, *e*, on platform, C, and at its upper end it is in a position to bear against the periphery of a sector-wheel, *f*, fixed to the spindle *g* of valve in gas-pipe B. *c* is a bent spring, applied to arm O, to hold it against the sector-wheel *f*, and, when escaping from the periphery thereof, to swing it on its fulcrum. The arm O at *p*, between its two ends, is insulated.

h is a finger-piece projecting horizontally from lower end of arm O. This finger-piece *h* at its outer end lies in a position between the two pins *l* and *m*, projecting horizontally one above the other from the block *e*. The lower pin, *l*, extends wholly through the block *e* and similarly projects therefrom upon its other side, being there lettered as l^2. The upper pin, *m*, only enters the block, but on the opposite side of the block thereto a similar pin, m^2, is located, also only entering the block.

Q is an arm, similarly constructed, arranged, and hung on the block *e* to the arm O. This arm Q is in position to bear upon the periphery of a sector-wheel, *n*, fixed to the gas-valve spindle *g*, and for its finger-piece h^2 to lie in and between the projecting pins l^2 and m^2 of the block *e*. The sector-wheel *n* is back of the sector-wheel *f*. The two sector-wheels, *f* and *n* are of equal diameter, of an equal length of arc—that is, a half of a circle. The two together complete the circumference. The relative location of the sector-wheels *f* and *n* on the valve spindle is such that with the arm O on the periphery of its sector-wheel *f* the arm Q will be off the periphery of its sector-wheel *n*, and vice versa; and the purpose of the said sector-wheels is to turn their respective arms O Q, so as to bring about a bearing between their respective finger-pieces $h\ h^2$ and the lower pins, $l\ l^2$, and also to allow the springs applied to the said arms O Q to react and bring their finger-pieces into contact with the upper pins, $m\ m^2$.

R is a ratchet-wheel secured to gas-valve spindle back of inner sector-wheel *n*, and S a spring, pawl, hung to lever H, and
137 arranged from the movement of such lever to act upon the ratchet-wheel R to turn it in the direction of the arrow, Fig. 1, plate 1. In lieu of a ratchet-wheel, a friction wheel and clutch may be employed, such as shown in Fig. 5.

M and N are wires leading from the electric battery employed. The wire M is to let on and the wire N to shut off the gas at the burner A. The current is thrown into the one or the other of said wires by means of a double switch, such as is employed ordinarily in electrical gas-lighting apparatuses, and therefore needs no particular description herein. The wire M connects with the arm O and the wire N with the arm Q.

T is a wire connecting lower pin, *l*, with magnet E, and U a wire connecting magnet with circuit-breaker J.

V and W are wires respectively connected with upper pins, *m* and m^2, from which they are to lead to the next burner, and to such burner become the letting-on and turning-off wires, as the wires M and N to the burner A.

The position of the several parts composing the mechanism hereinabove described is at all times, if at rest, substantially that shown in Fig. 1, plate 1, and only differs therefrom in any condition of rest in the relative positions of the two arms O Q, according as one or the other is bearing on its respective sector-wheel, *f* or *n*.

By the shown positions of the two arms O and Q, the finger-piece *h* of the arm O is against the lower pin, *l*, and the finger-piece h^2 of arm Q against the upper pin, m^2, of block *e*. This relative contact with the pins $l\ l^2\ m\ m^2$ of the finger-pieces to the two arms is always maintained, they never being both at the same time in contact with the lower pins, $l\ l^2$, or the upper pins, $m\ m^2$, but always the one with a lower pin and the other with an upper pin alternately.

With the arms O and Q in the relative positions described and shown, if now a current of electricity be thrown into the wire M, (which, as stated, is the letting-on wire,) it is obvious it will pass into the magnet, (the connection being through arm O, finger-piece *h*, pin *l*, and wire T,) thence to the circuit-breaker J, and then as the circuit is complete the armature G will be drawn toward the magnet, turning its lever H on its fulcrum, which carries the circuit-breaker J beyond the end of the platinum arm *b*, breaking thereby the circuit and emitting an electric spark. This breaking of the circuit destroys the attractive force of the magnet and leaves the lever H to be pulled backward by the spring L, which backward movement of the lever completes the circuit by bringing the circuit-breaker into contact with the platinum arm *b*, when another attraction of the armature G occurs, again breaking the circuit emitting a spark, and so on as before. By this alternate forward and backward movement of the lever H, the ratchet-wheel R, on gas-valve spindle is intermittently rotated, carrying with it the valve spindle *g* and sector-wheels *f n*. If this rotation of the valve spindle *g* be continued sufficiently the periphery of the sector-wheel *f* will be carried beyond the arm

O, leaving it free for its spring to act upon it and thus to throw its finger-piece *h* out of contact with the lower pin, *l*, and into contact with the upper pin, *m*, and the periphery of the sector-wheel *n* will be brought to bear upon the arm Q, throwing its finger-piece h^2 out of contact with the upper pin, m^2, and into contact with the lower pin, l^2.

With the movement of the sector-wheel *f* beyond its arm O, and of the sector-wheel *n* onto its arm Q, as above described, results have been effected as follows: First, the gas-valve or stop-cock has been opened to its fullest extent, and as at each stroke of the lever H, caused by the successive attraction of the armature, the circuit was broken and a spark emitted, it is obvious the gas necessarily must have been lighted; second, the current of electricity through wire M is cut off from the magnet E and thrown into the wire V, leading to the magnet of the next burner, and which, as before stated, is the letting-on wire to such burner; third, a connection has been established between the magnet E and the shutting-off wire N, so that when desired to shut off the gas from the burner A the operator has only to make the necessary connection between battery and shutting-off wire.

The connection between shutting-off wire N and magnet is through arm Q, its finger-piece h^2, pin l^2, and wire T.

In shutting off the gas at the burner the operation of the parts is precisely similar to the letting on of the gas, and therefore needs no particular description, and on its completion the arm Q escapes from its sector-wheel *n* and the arm O passes on to its sector-wheel *f*, re-establishing the connection between letting-on wire and magnet, as before.

Completing the shutting off of the gas at one burner throws the current into the wire W, leading from such burner A to the next burner, which wire W to the said next burner is the shutting-off wire.

In Fig. 4 the valve in gas-pipe is shown in detail, and it is such that in a half-turn of the spindle *g* the gas will be let on, and, continuing the turn, shut off.

The location of the circuit-breaker at the gas-burner is such, that as it breaks the circuit by escaping from the platinum arm *b* the spark emitted will be sufficiently near to the escaping gas as to ignite the same, and it is desirable that the movement to let on the gas should be so divided as to admit a sufficient number of sparks to insure the lighting of the gas.

138 I do not claim turning on and off gas by means of a step-by-step motion, as such is not my invention.

Having thus described my invention, I shall state my claims as follows:

1. A circuit-breaker, located at the burner and operated automatically, substantially as described.

2. In combination with the above a lever, adapted and arranged to open and close the stop cock or valve of the burner and carrying the circuit-breaker, substantially as herein described.

3. The arms O Q, sector-wheels *f n*, pins *l* l^2 *m* m^2, wires M N, mag-

S. GARDINER, Jr. 141

Electric Gas Lighter and Extinguisher.

No. 55,642. Patented June 19, 1866.

No. 232. Electric Gas Lighting Co. vs. Boston Electric Co. } p. 141

Fig. 2.

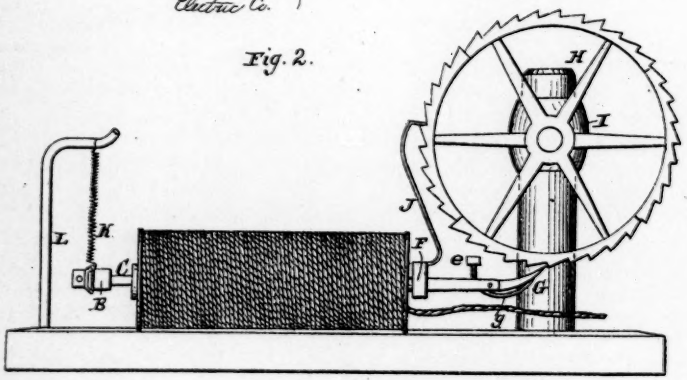
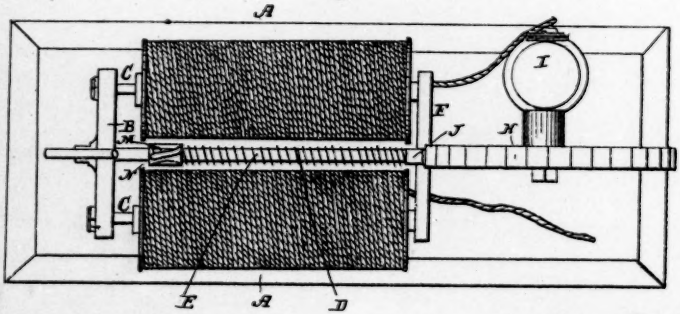


Fig. 1.



Witnesses:
P. E. Wilson
C. D. Smith

Inventor:
Saml. Gardiner Jr.

net E, lever H, carrying armature G, circuit-breaker J, and pawl S, and the ratchet-wheel R, all combined and arranged together and applied to a gas-burner for operation substantially as and for the purposes set forth.

The above specification of my invention signed by me this 4th day of June, A. D. 1872.

J. P. TIRRELL.

Witnesses:
EDWIN W. BROWN.
ALBERT W. BROWN.

142 UNITED STATES PATENT OFFICE.

SAMUEL GARDINER, Jr., of New York, N. Y.

Improvement in Turning Gas-Cocks by Electro-Magnetism.

Specification forming part of Letters Patent No. 55642, dated June 19, 1866.

To all whom it may concern:

Be it known that I, Samuel Gardiner, Jr., of the city, county, and State of New York, have invented a new and improved electro-magnetic apparatus for turning on gas; and I do hereby declare the following to be a full, clear, and exact description of the nature, construction, and operation of the same, sufficient to enable others skilled in the art to which it appertains to fully understand and use the same, reference being had to the accompanying drawings, which are made a part of this specification, in which—

(Here follows diagram marked p. 141.)

Figure 1 is a plan of my improved apparatus. Fig. 2 is a side elevation of the same.

Similar letters of reference indicate corresponding parts in the two figures.

This invention relates to an apparatus in which an armature is employed, in conjunction with an electro-magnet, to give motion to a wheel whose rotation serves to turn a pipe-cock, and thus let on and shut off the gas.

The invention consists in a novel method of applying and supporting the armature, in novel devices for transmitting its motion to the wheel, and in the means whereby the rotation of the wheel is limited and controlled.

In the annexed drawings, A A may represent the helices composing an electro-magnet. B is an armature or metallic bar supported upon short shafts C C, projecting longitudinally from the helices A A, and constituting guides upon which the armature slides during its inward and outward movements, the former being effected by the influence of the magnet, and the latter by the helical spring D.

This spring encircles a sliding rod, E, placed parallel with and between the helices A A, and secured to the armature B. The rod E extends and slides through the bar F, which forms the heel of the magnet.

To the end of the rod E is pivoted a click, G, which is made to engage with the teeth of a wheel, H, by the spring *g*. The motion of the wheel H turns the cock I of the gas-pipe, and so turns the gas off and on.

e is a pin or stud projecting from the rod E, and employed to limit the rotation of the wheel H, or rather determine the extent of motion which the latter undergoes when the armature B is acted upon by the magnet.

J is a spring attached to the bar F, and taking into the teeth of the wheel H, in order to prevent the reverse movement of the latter by the retraction of the click G.

To the armature B is attached a helical spring, K, depending from the curved standard L. This spring K sustains the armature to a sufficient extent to overcome the effect of gravity, and thus impart a freedom of motion to the armature and avoid the restraint which would otherwise result from friction while moving upon the guides C C.

The operation of the above-described apparatus may be briefly explained: The helices are magnetized and neutralized, or the circuit is formed and suspended, in the ordinary manner. When influenced by the magnet the armature is drawn against the helices, and the sliding rod E is advanced in the direction of the wheel H, which causes the click to give a partial rotation to the said wheel, and thereby turn the cock I to a corresponding extent. As a repetition of these movements of the sliding rod E is requisite, the circuit is broken and created and the sliding rod advanced and retracted till the desired end is attained. The armature is retracted or moved away from the magnet by the helical spring D, which is contracted by the armature when the latter is moved by the magnet.

As before stated, the click G is prevented from acting upon the wheel H during its return or backward movement by the retaining-spring J.

Dark and light colors on the face of the wheel H are made to indicate the position of the cock, so that a glance will be sufficient to ascertain whether the gas is fully or partially turned on or off.

M is an adjustable collar, which may be set in different positions on the sliding rod E by means of the thumb-screw N, so as to vary the tension or force of the spring D. The closing of the gas-cock is effected by continuing its rotation in the manner described.

Having thus described my invention, the following is what I claim as new herein and desire to secure by letters patent:

1. Turning a gas-cock by means of a sliding rod, E, and click G, acting directly upon the toothed wheel H on the axis of said
143 gas-cock, and employed in combination with an armature, B, and magnet A A, substantially as described.

2. The combination, with the armature B, of the guides C C and spring K, substantially as and for the objects specified.

W. W. HOPKINS.

Electric Gas Lighter.

No. 22,952.

No. 232.
Electric Gas Lighting Co. v. Boston Electric Co. } p. 145

Patented Feb. 15, 1859.

Fig. 1.

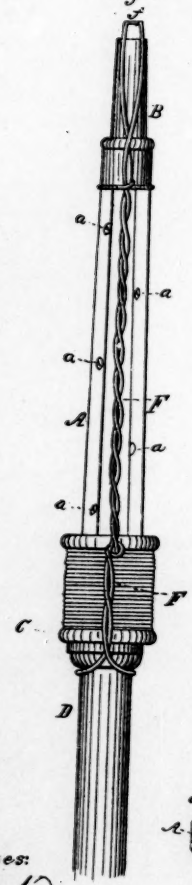


Fig. 2.

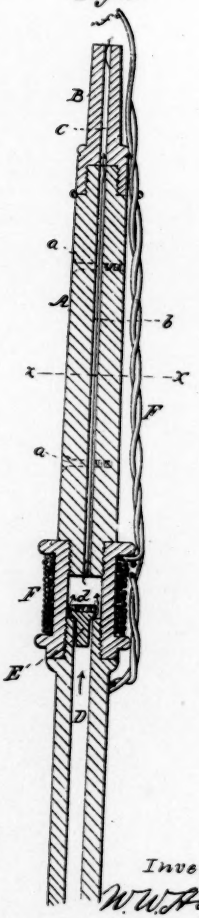


Fig. 3.

Witnesses:
J. R. Foster
Wm. E. Hall

Inventor:
W. W. Hopkins

3. The stop or stud *e*, attached to the sliding rod E, and employed to limit the motion of the wheel H, as set forth.

4. The combination, with the wheel H, rod E, and click G, of the retaining-spring J, applied and operating in the manner and for the purpose substantially as described.

5. In combination with the apparatus herein described, the helical spring D, adjustable collar M, and thumb-screw N, arranged as described, and employed for the purposes specified.

SAM'L GARDINER, JR.

Witnesses:
P. E. WILSON.
C. D. SMITH.

146 UNITED STATES PATENT OFFICE.

W. W. HOPKINS, of Amelia, Ohio.

Improved Method of Lighting Gas by Galvanic Electricity.

Specification forming part of Letters Patent No. 22952, dated February 15, 1859.

To all whom it may concern:

Be it known that I, W. W. Hopkins, of Amelia, in the county of Clermont and State of Ohio, have invented a new and improved apparatus for letting on gas to burners and lighting and shutting off the same by electricity; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification, in which—

(Here follows diagram marked p. 145.)

Figure 1 is a side view of a gas pipe and burner with my apparatus applied. Fig. 2 is a central vertical section of the same. Fig. 3 is a horizontal section in the line *x x* of Fig. 2.

Similar letters of reference indicate corresponding parts in the several figures.

To enable others skilled in the art to make and use my invention, I will proceed to describe its construction and operation.

A is a permanent magnet, composed of two or more bars placed side by side and united by screws *a a* or other means, each of said bars being grooved longitudinally in such a manner that when united together their grooves combine to form a passage, *b*, throughout the whole length.

B is the burner, screwed onto the permanent magnet so that its passage *c* forms a continuation of the passage *b*.

C is a valve-chamber, made of brass or other unmagnetic substance, of cylindrical form, and having the permanent magnet A screwed into its upper end, and the iron pipe D, by which the gas is supplied, screwed into its lower end.

E is the electro-magnetic valve, made of iron, of a size and form to move freely up and down within the chamber C and to leave a passage or passages between it and the sides of said chamber, and to be supported on the bottom of the said chamber, or on the top of the supply-pipe D, and to enter a considerable distance into the supply-pipe, so as to present a considerable attractive surface to said pipe without requiring it to be very large and heavy.

By making the valve of considerable depth it is also caused to present a greater surface to the attractive force of the permanent magnet when it is up against the bottom of said magnet, which constitutes its seat. The said valve has a cavity in the top to receive a globule of quicksilver, *d*, for the purpose of insuring its closing perfectly the lower orifice of the passage *b* when up to its seat at the bottom of the permanent magnet. The depth of the valve-chamber is such that when the valve is at the bottom of it the attraction of the permanent magnet A is not of itself sufficiently powerful to raise it.

The mouth of the supply-pipe D has notches *e e* cut in its sides, for the passage of the gas around the valve when the latter is down at the bottom of the chamber.

F is the copper conducting-wire of the battery which I employ to effect the operation, coiled round the exterior of the valve-chamber C, to convert the iron valve into an electro-magnet, and passing near the top of the burner, where there is a break, which is closed by a short piece of finer platinum wire, *f*, which is situated above and so near the outer orifice of the burner that the gas in issuing therefrom will impinge upon it.

The battery employed must be furnished with a pole-changer to change the polarity of the ends of the extremities of the conducting-wire F, and with a key to open and close the circuit.

The operation is as follows: To let on the gas the circuit is closed with the pole-changer in position to cause the electro-magnetic valve E to present a similar polarity towards its seat at the bottom of the permanent magnet, and thus to produce a repulsion between the valve and its seat, which causes the valve to fall by gravitation to the bottom of the chamber C, and thus to open a passage for the gas through the pipe D and the permanent magnet to the burner, as indicated by the arrows in Fig. 2. The platinum wire *f* becomes heated to a white heat, and the gas issuing from the burner is thereby ignited. To shut off the gas the pole-changer is shifted to change the direction of the current through the wire F and reverse the polarity of the electro-magnetic valve, thus causing the latter to present an opposite polarity towards its seat, and causing them to attract each other, and thereby causing the valve to be raised to its seat and the lower orifice of the passage *b* to be closed and the gas to be shut off from the burner.

The circuit through the wire F may be opened as soon as the gas is let on and ignited, or as soon as it is shut off, as in the former case the weight of the valve keeps it open and in the latter the attraction of the permanent magnet keeps it closed.

147

A single battery may be made to light any number of burners,

FROST & LAWRENCE.

Electric Gas Lighter.

No. 49,254.

No. 232.
Electric Gas Lighting Co.
v.
Boston Electric Co
p. 149.

Patented Aug. 8, 1865.

Fig. 2.

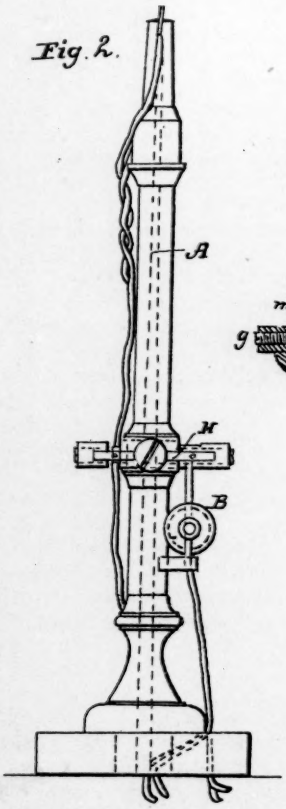


Fig. 4.

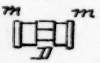
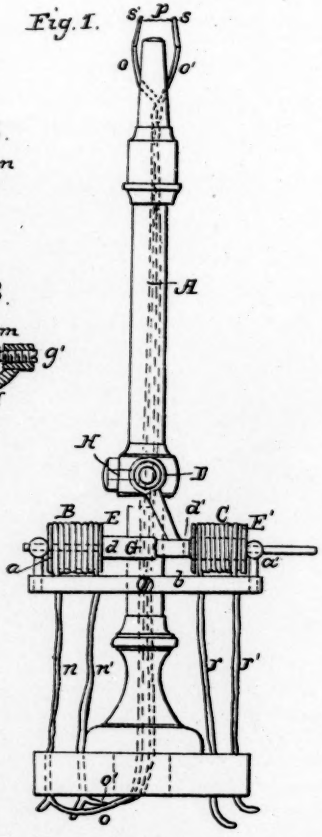


Fig. 3.

Fig. 1.



Witnesses:
J. B. Goddard
Milton Bradley

Inventor:
Edward S. Frost
George H. Lawrence

even to the whole number employed in a large building or the whole number of street-lamps in city, by leading the conducting-wire in a proper manner (which will at once suggest itself) from one burner or lamp to another.

I do not claim, broadly, the letting on of gas to burners by electricity, or the lighting of gas by heat generated in a platinum wire by a current of electricity passing through it; but

What I claim as my invention, and desire to secure by letters patent, is—

The arrangement and combination of the hollow permanent magnet A, valve-chamber C, coil F, electro-magnetic valve E, and tube D, as and for the purpose herein shown and described.

W. W. HOPKINS.

Witnesses:
J. R. FOSTER.
W. B. C. STIRLING.

150 UNITED STATES PATENT OFFICE.

EDWARD J. FROST and GEORGE A. LAWRENCE, of Springfield, Mass.

Improvement in Electric Gas-Lighters.

Specification forming part of Letters Patent No. 49254, dated August 8, 1865; antedated July 24, 1865.

To all whom it may concern:

Be it known that we, Edward J. Frost and George A. Lawrence, of Springfield, Hampden county, State of Massachusetts, have invented a new and improved electric gas-lighter; and we do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

(Here follows diagram marked p. 149.)

In the drawings, figure 1 is a front view; Fig. 2, a side elevation, and Fig. 3 a cross-section, showing the valve; and Fig. 4, a side view of the valve.

The object of our invention is to obtain an economical apparatus by means of which a large number of gas-lamps may be lighted at the same time by means of an electric current.

To the ordinary gas pipe and burner A we attach a peculiar form of valve, D, and the mechanism for opening and closing the same, consisting of two helices, B C, wound on the bobbins E E′, concentric with which is a bar of soft iron, G, playing in guides *a a′*, attached to cross-piece *b*, which is secured to the post.

The bar or cylinder G is arranged with the two ends turned down very small where they pass through the guides, and the parts *d d′* on each side of the center larger for some distance, and so ar-

ranged in regard to length that one of these parts d d' shall be inside of the bobbin while the other is between the two and nearly outside of the other. Connected with this piece is the lever e, which is attached at the other end to the valve D. This valve is formed of the frustum of a cone, as shown in Figs. 3 and 4, with a part of the metal turned off, so that it bears only at the two ends and, when closed, over the opening through which the gas flows. These bearings m m' are hardened and ground to insure an accurate fit, and the valve is mounted on the screw-centers g g', which are secured in the yoke H, fastened to the pipe. These centers are also hardened and support the valve, so that the only friction is between them and the hardened ends of the valve D. Also, whatever wear there may be between the valve and socket which would produce leakage is overcome by loosening the screw g and setting up g'.

In the drawings, the helices B and C have each two wires, which pass to the battery and form the two poles, so that a circuit is formed whenever they are connected with it. Also, connected with the wires n n' are the wires o o', which form a part of the same circuit. In practice, however, only two wires will be needed, as in both cases the pipe may be used as one part of the circuit, as will be seen in the description of the operation, which is as follows:

We will suppose the gas to be shut off and the mechanism in the position shown in the drawings. In order to open the valve and light the gas, the wires n n' are connected with the battery, so that the current passes over the wire n, around the helix B, and back to the battery over n', thus completing the circuit and forming an electro-magnet of the coil B. This attracts into its center the cylinder G until the part d becomes central with it, thus, by means of the lever e, connected with G, opening the valve D and letting on the gas. Also, the current flows on over the wire o and across the small wire p, between the poles s s', to the wire o', and back to the battery. In passing over the wire p sufficient heat is produced to ignite the gas. It will be seen that by this means the gas is let on before the current produces the heat at the burner which ignites the gas, and thus a light is always sure as soon as sufficient heat is generated to ignite the gas. The wires n n' are now disconnected from the battery and the wires r r' connected, so that a current is formed around C, attracting d' into its center, thus closing the valve and shutting off the gas.

What we claim as new, and desire to secure by letters patent, is—

1. The combination of an electric magnet with a valve, D, or its equivalent, when applied to the pipe of a gas-burner and operated by means of the axial bar G, as set forth.

2. The valve D, as described, when used in combination with the axial bar G, or its equivalent, substantially as described.

EDWARD J. FROST.
GEORGE A. LAWRENCE.

Witnesses:
J. B. GARDINER.
MILTON BRADLEY.

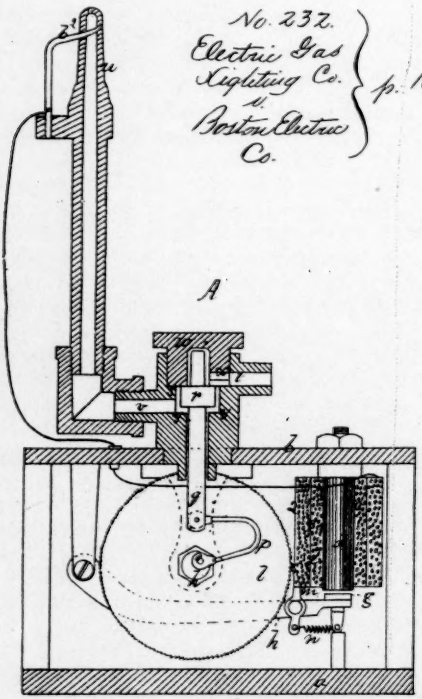
F. Bean.

153

Electric Gas-Lighting App.

No 73868 Patented Jan. 28, 1868.

No. 232.
Electric Gas Lighting Co. v. Boston Electric Co.
} p. 153



Witnesses

S. B. Kinder
M. W. Fothingham

Inventor:

F. Bean
by his Attys
Cady, Hazlett & Cady

154 UNITED STATES PATENT OFFICE.

FRANK BEAN, of Boston, Massachusetts, assignor to himself, E. E. Bean, and Levi H. Straw.

Letters Patent No. 73868, dated January 28, 1868.

Improvement in Electric Gas-Lighting Apparatus.

The schedule referred to in these letters patent and making part of the same.

To all whom it may concern:

Be it known that I, Frank Bean, of Boston, in the county of Suffolk and State of Massachusetts, have invented an improved electric gas lighting and extinguishing apparatus; and I do hereby declare that the following, taken in connection with the drawings which accompany and form part of this specification, is a description of my invention sufficient to enable those skilled in the art to practise it.

My invention relates to a method for lighting gas by means of an electric circuit, the invention being particularly applicable to lighting and extinguishing street gas-lamps, by an electric telegraph or circuit, which, through an electro-magnet and armature connected with each gas-burner or lamp, is made to operate a ratchet-wheel, connected to and actuating a valve or cock for opening and shutting off supply of gas to the burner, each magnetic coil being surrounded by a secondary coil of wire, in which secondary coils, by the action of the primary coils, a spark-producing current is induced, so that by connecting one secondary coil with the burner, and the other secondary coil with an insulated platina point, brought close to the tip of the burner, or to the gas-issuing orifice, a spark or succession of sparks is produced, which lights the gas.

(Here follows diagram marked 153.)

The drawings represent at A a sectional elevation of my apparatus, used in connection with each burner, and at B a front elevation of the magnetic coils and armature.

a denotes the base, and *b* the top plate of a box, for containing the mechanism to be connected with each lamp. *c c'* denote two connected magnetic coils, each composed of a bundle of soft, fine iron wires, *d*, surrounded by a coil of coarse wire, *e*. The poles of these coils are connected, by the wires *f*, with the main circuit, in which circuit is the series of lamps, connected, by the main circuit wire, with the main station. *g* denotes an armature mounted on a rocker-lever, *h*, fulcrumed at *i*, and arranged to be attracted by both poles of the centre wires, as seen at B. Beneath the plate *b* is mounted, in suitable bearings, a shaft, *k*, carrying a ratchet-wheel, *l*, which ratchet is worked by a pawl, *m*, hung upon the armature-lever *h*, the point of the pawl being held against the

ratchet by a spring, *n*. On one side of the ratchet-wheel is a crank-pin, *o*, to which is jointed a ⊃-shaped spring, *p*, as seen at A, the upper end of the spring being connected to a valve-rod, *q*, which carries a valve, *r*, working in a valve-chamber, *s*. This chamber is connected with the gas-supply pipe, through an orifice, *t*, and with the burner *u*, through an orifice *v*. A plug, *w*, is inserted or screwed into and closes the top of the chamber *s*, an orifice, *x*, being made through this plug, and the connection of the gas-inlet orifice *t* with the valve-chamber being through orifice *x*, and the bottom of this plug constitutes a seat, against which the upper face of the valve is carried, to cut off the connection of the supply-pipe with the burner, this being effected when the valve is raised. At the bottom of the valve-chamber is a valve-seat, *y*, against which the lower face of the valve is brought, when the valve is drawn down to open the connection between the burner and the supply-pipe, the valve at such time closing the valve-tube of the valve-rod, and preventing all escape of gas down through the valve-rod tube.

Connected with the main circuit is a circuit-breaker, by operating which, in the well-known manner, the armature is alternately attracted by and repelled from the magnets, each upward movement of the armature with the pawl effecting movement of the ratchet-wheel one or more teeth, the number of intermittent movements of the armature, and the consequent extent of rotation of the ratchet-wheel, being controlled by the circuit-breaker. The movement of the ratchet-wheel communicates through the crank pin *o*, and the connecting-spring *p*, of the valve, movement to either close or open the connection between the gas-burner and the gas-supply pipe, as may be necessary, as will be readily understood.

By making the connection between the valve-rod and the ratchet-crank, by means of the spring, as described, the valve is always sure to be pressed against its respective seats when the ratchet turns the crank-pin to its highest and lowest positions, and is held there by pressure of the spring, while the spring-connection allows the crank-pin to continue its rotation, at proper times, after the valve is forced against either seat.

The arrangement of the valve and the passages into and from the valve or gas-chamber, allows the valve and rod to be loosely fitted in the valve-chamber, so as to freely move without possibility of obstruction. Each main circle *c c'* of the electro-magnet is surrounded by a secondary coil, *z*, and the two coils *z* being connected by a wire, a^2, an electric current is induced in these coils *z*, so that if the two poles are brought into connection, to make a circuit, a spark or series of sparks will be generated. For this purpose I connect one pole with the metal plate *b*, and thereby with the top of the burner, and the other pole with an insulated platina-pointed wire b^2, the point of which is brought to such distance from the jet-point of the burner that when the current is prodnced in the secondary coil, a spark will fly from the platina point to the burner, and the gas, at each vibration of the armature and movement of the ratchet, if turned on, will be lighted by the spark or sparks thus produced.

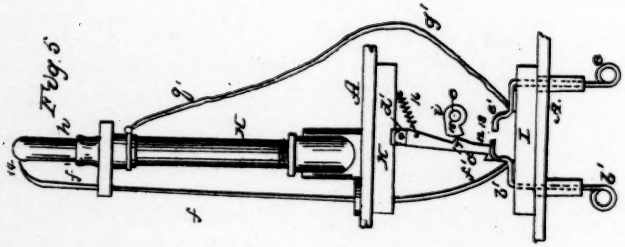
159

2 Sheets—Sheet 2.

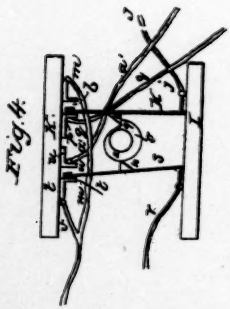
E. E. BEAN.

Electric Gas Lighter and Extinguisher.

No. 90,629. Patented June 1, 1869.



No. 232.
Electric Gas Lighting Co.
v.
Boston Electric Co.
p. 159.



Witnesses
[illegible]

Inventor
Edwin E. Bean

2 Sheets—Sheet 1.

E. E. BEAN.

Electric Gas Lighter and Extinguisher.

No. 90,629. Patented June 1, 1869.

No. 232.
Electric Gas Lighting Co.
v.
Boston Electric Co.
p 157.

Fig. 2

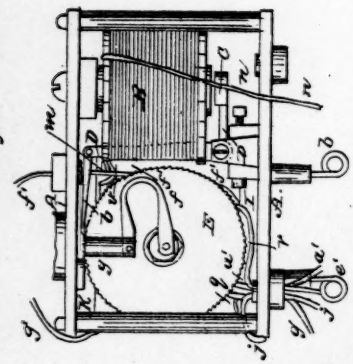


Fig. 3

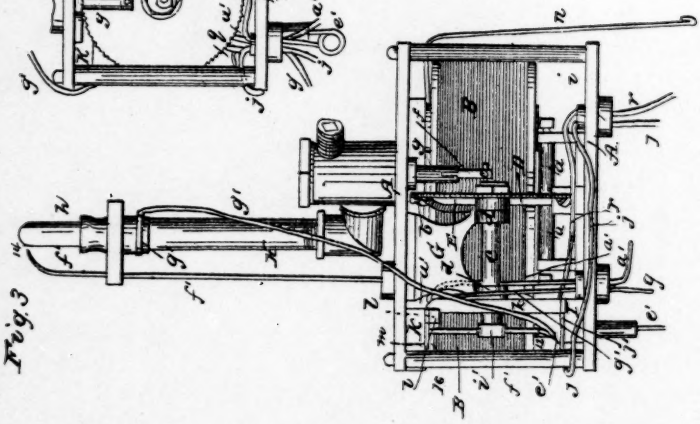
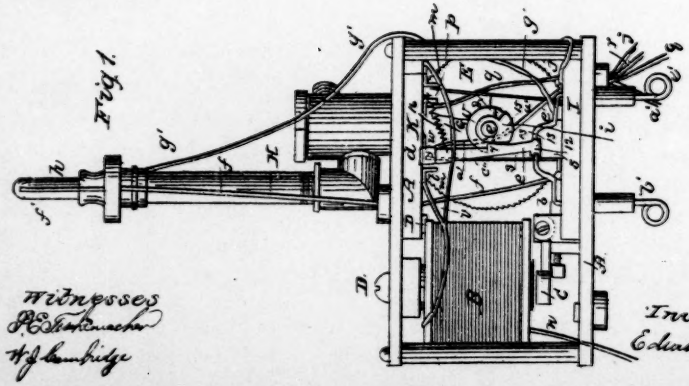


Fig. 1



Witnesses
P. E. Sinclair
H. J. Cambridge

Inventor
Edward E. Bean

As spark-producing coils have heretofore been made, the poles have been at the opposite ends of a long central bundle of wires, the armature vibrating to and from one end only. To get the full power of the primary coil, to attract the armature, for the purpose of using the coil not only as a spark-producing coil, but as a coil to effect, through the armature, the movement of the ratchet, and through such movement the opening and closing of the valve, and to arrange the coil within the smallest practical space, I make it in two parts, as shown, connecting the two primary helices by the wire, and the two secondary helices by the wire, and arranging the armature to be attracted by both centre bundles of wire, as shown.

No Rumkoff or spark-producing coil has, to my knowledge, been thus arranged, or, through such arrangement, has been made to not only produce the sparks through the secondary current, but to produce an intermittent movement of a ratchet-wheel through its primary current.

1. I claim, in combination with the ratchet and its crank, the spring connecting the crank to the valve-rod, substantially as shown and described.

2. I also claim the combination and arrangement of the valve, the valve-chamber, and the inlet and outlet for the gas, when the valve is so arranged that it shuts off communication between the valve-chamber and the valve-rod tube when connection is open between the supply-pipe and the burner, and shuts off communication between the supply and burner-pipes when the gas is not burning.

FRANK BEAN.

Witnesses:
J. B. CROSBY.
FRANCIS GOULD.

160 UNITED STATES PATENT OFFICE.

EDWIN E. BEAN, of Boston, Massachusetts.

Apparatus for Lighting and Extinguishing Gas by Electricity.

Specification forming part of Letters Patent No. 90629, dated June 1, 1869.

To all whom it may concern:

Be it known that I, Edwin E. Bean, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain improvements in electric apparatus for lighting and extinguishing gas, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, making part of this specification, in which—

(Here follow diagrams marked pp. 157 & 159.)

Figure 1 is an elevation of one side of my improved apparatus. Fig. 2 is an elevation of the opposite side of the same. Fig. 3 is an end elevation of the same; Figs. 4 and 5, details to be referred to.

The electric apparatus or mechanism heretofore used for lighting and extinguishing gas, in which a ratchet-wheel, connected with the gas cock or valve, is rotated by a pawl operated by an electro-magnet, is objectionable, for the following reasons:

Where a number of lamps are placed in a circuit, it has been found impossible to so regulate the mechanism connected with each one as to cause the ratchet-wheels to be moved the same distance at each forward vibration of the pawls, the momentum received from the rapid action of the latter causing some of the ratchet-wheels to be carried beyond the desired point, in consequence of which the gas would in some places be let on and in others partially or wholly shut off.

Furthermore, where a number of lamps are included in the same circuit, so that the several apparatus will be operated simultaneously, a very powerful current of electricity is required to convey, which necessitates the employment of a wire of large diameter, thus increasing the expense.

The first part of my invention has for its object to overcome the above-mentioned difficulties, and consists in operating one apparatus only at a time, two separate wires being employed (one to let on and the other to shut off the gas), in connection with an automatic circuit-breaker in each apparatus, the current of electricity passing through one wire to the electro-magnet of the first apparatus in the circuit (returning through the ground), and as soon as the gas-valve of this apparatus has been opened or closed, as the case may be, the motion of the mechanism connected therewith is instantly arrested by the breaking of the circuit, the current being, by the same movement of the automatic circuit-breaker, connected with a wire leading to the next apparatus, when the operation is repeated, and so on throughout the whole series of lamps, one apparatus only being included in the circuit at a time, and the breaking of the circuit in each apparatus serving to connect the electro-magnet with the other wire, by the current of which the mechanism may be again set in motion, the two wires being used alternately, one to let on and the other to shut off the gas.

The second part of my invention relates to certain improvements in that portion of the apparatus used for igniting the gas by an electric spark.

Where a number of lamps are included in a circuit, and lighted simultaneously, as has heretofore been customary, the electric spark is forced to leap over a corresponding number of breaks (one at each gas-burner); and to overcome the aggregate resistance occasioned by these breaks, an exceedingly powerful current of electricity is required, necessitating an expensive covering of great thickness around the conducting-wire, in order to secure the required insulation to prevent the escape of the electricity.

This part of my invention has for its object to prevent this great expenditure of electric power, and also enables me to employ a thinly-coated, and consequently less expensive, conducting-wire; and consists in breaking and closing the electric-lighting circuit at any desired point, for the purpose of producing the sparks to ignite

the gas by means of automatic mechanism, as will be hereinafter particularly described.

To enable others skilled in the art to understand and use my invention, I will proceed to describe the manner in which I have carried it out.

In the said drawings A represents the frame-work of the apparatus, to which is secured the electro-magnet B, the armature C of which is secured to the end of a bent lever, D, which is attached to a horizontal rock-shaft, *a*, and has pivoted to its upper end a pawl, *b*, which engages with the teeth of a ratchet-wheel, E, the shaft *c* of which revolves in bearings *d* in a bifurcated plate, G, projecting down from the upper plate of the frame-work.

161 From the hub of the ratchet-wheel E projects a crank-pin, *e*, which is connected by means of a spring, *f*, to the lower end of the stem *g* of the valve, through which the gas is admitted to the pipe H and burner *h*.

The construction of this valve and the spring-connection between its stem and the crank-pin, however, form no part of the present invention, being the subject of letters patent granted to Frank Bean on the 28th day of January, 1868, and will not therefore be further described.

I will now proceed to describe the manner in which the electric current is caused to pass through the apparatus for the purpose of rotating the ratchet-wheel E to open and close the gas-valve at the required times.

The parts being in the position seen in Fig. 1 (the gas-valve being closed), the electric current enters the apparatus at *i* by the wire *j*, through which it passes to the base of a flat spring, *k*, secured to an insulating-block, I. The upper end of this spring *k* rests against a bent plate, *l*, secured to an insulating-block, K, the current passing through the spring *k* and bent plate *l* to a wire, *m*, connected with the electro-magnet B, after passing through which the current is conducted by the wire *n* to the ground or the street gas-pipe, by which it passes to the negative pole of the battery to complete the circuit, when the armature C may be set in motion by means of a key at the central station in a well-known manner, and the pawl *b* vibrated to produce the rotation of the ratchet-wheel E, the motion of which is instantly arrested as soon as it has completed a half-revolution, (which opens the gas-valve to its full extent,) in the following manner: *o* is a cam, composed of non-conducting material, and secured to the end of the shaft *c*. This cam bears against a triangular projection, 8, on the spring *k*, and serves to keep its upper end in contact with the bent plate *l* until its point 9, Fig. 4, is carried past the point of the projection 8, (which occurs the instant the ratchet E has completed a half-revolution,) when the spring assumes the position seen in Fig. 4, with its upper end resting against a bent plate, *p*, secured to the insulating-block K, opposite to the bent plate *l*. This serves to break the circuit through the electro-magnet B and arrest the motion of the ratchet E, when the electric current will pass through the spring *k* to the bent plate *p*, and thence by a wire, *q*, to the next apparatus, when the same operation is repeated,

and so on throughout the whole series of lamps, one apparatus only being included within the circuit at a time, the electric current passing from one to another in succession until it has passed through the entire series; and thus, as one armature only, with the mechanism connected therewith, is operated at a time, an electric current of very moderate power only is required and consequently a wire of small diameter and moderate cost may be employed, while the automatic breaking of the circuit, which arrests the ratchet-wheel and causes the current to pass on to the next lamp, renders it absolutely certain that the gas-valve will be left in the exact position required.

The gas, having been let on, is ignited by electric sparks, in a manner to be hereinafter particularly described.

It is evident that the armature C cannot be again set in motion (when it is desired to extinguish the gas) by a current passing through the wire *j*, on account of the circuit having been broken, as above described.

It therefore becomes necessary to employ another wire, *r*, through which the electric current passes to the base of a flat spring, *s*, (on the opposite side of the cam *o*,) the upper end of which rests against a bent plate, *t*, secured to the insulating-block K, when the parts are in the position seen in Fig. 4. This plate is connected with a wire, *v*, through which the current passes to the electro-magnet B, and by the wire *n* to the ground and back to the battery, as before.

The armature C may thus be again set in motion and the wheel E rotated, for the purpose of closing the valve and extinguishing the gas.

The spring *s* is provided with a projection, 10, (similar to that 8 of the spring *k*,) which rests against the cam *o*, the latter serving to retain the upper end of the spring in contact with the plate *t* until the revolution of the ratchet E carries the point 9 of the cam past the point of the projection 10, when the spring *s* will assume the position seen in Fig. 1, with its upper end resting against a bent plate, *w*, secured to the block K opposite to the plate *t*. This movement of the spring *s* occurs the instant the gas-valve is entirely closed by the half-revolution of the ratchet E, and serves to break the circuit through the electro-magnet B, and thus arrest the motion of the ratchet E, which insures the gas-valve being left closed, as required.

The current now passes by the spring *s* to the plate *w*, and thence by a wire, *a'*, to the next apparatus, where the same operation is repeated, the current passing successively from one lamp to another until the whole are extinguished.

Just previous to the arrival of the point 9 of the cam *o* opposite to the projection 10 the portion 11 of the cam strikes against the projection 8 of the spring *k*, forcing its upper end away from the plate *p*, and bringing it into contact with the plate *l*, as seen in Fig. 1, against which it is held by the cam when its motion is arrested by the breaking of the circuit caused by the movement of the upper end of the spring *s* from the plate *t* to the plate *w*. The parts are thus left in such a position that the armature C may be again set in motion to open the valve by the current from the wire *j*, as first de-

scribed. The springs *k* and *s* are thus operated alternately by the cam *o*, in such a manner that the breaking of one circuit
162 through the wire *j*, spring *k*, and electro-magnet B will not only cause the current to pass on to the next apparatus, but will leave the electro-magnet B connected through the spring *s* with the other wire, *r*, through which a current may be transmitted at the required time, while the breaking of the circuit through the wire *r*, spring *s*, and electro-magnet B will cause the current to pass on to the next apparatus, and at the same time leave the electro-magnet connected, through the spring *k*, with the wire *j*, the wires *j r* being thus used alternately—one to carry the current for opening the gas-valve and the other the current for closing it—the electro-magnet being at all times connected with one or the other of the wires *j r*.

The electric current which produces the sparks for lighting the gas passes through the several apparatus, the spark being produced by the electricity passing over a break or interruption in the circuit at each burner.

The circuit, however, is broken at one point only at a time, this break being produced at each lamp in succession throughout the entire series until they are all lighted, in a manner which will now be described.

Just previous to setting in motion the mechanism which opens the gas-valves, the electric current which produces the sparks is caused to pass continuously through the several apparatus within the circuit, entering each one by the wire *b'*, from the point 12 of which it passes through a lever, *c'*, (pivoted at *d'* to the block K,) to the point 13 of a wire, *e'*, as seen in Fig. 1, by which it leaves the apparatus and passes on to the next one; and when the lever *c'* of each apparatus is in the position seen in Fig. 1, the circuit through the several apparatus is unbroken, and no spark is produced.

f' is a wire, one end of which is connected with the wire *b'*, the other extremity, 14, being brought into close proximity with the insulated tip of the gas-burner *h*, to which is secured another wire, *g'*, connected with the wire *e'*; and when it is desired to ignite the gas it becomes necessary to cause the electric current to follow the wire *f'* and leap over the break between its point 14 and the tip *h*, so as to produce the electric sparks at this point, and afterward pass from the burner *h* to the wire *g'*, and thence to the wire *e'*.

This is effected in the following manner: *i'* is a cam of non-conducting material, formed in the same piece with the cam *o*, and as the ratchet E is revolved into such a position as to partially open the gas-valve the portion 15 of the cam *i'* is brought into contact with the lever *c'*, when the latter is forced against the resistance of a spring, 16, away from the point 13 of the wire *e'*, as seen in Fig. 5, thus breaking the connection between the two wires *b'* and *e'* at this point; and, as the lever *c'* is moved, the instant the distance between its lower end and the point 13 exceeds the space between the point 14 of the wire *f'* and the tip of the burner *h* the electric current will pass through the wires *f' g'*, producing a stream of sparks at the

point 14, which ignites the gas issuing from the burner *h*, as required.

The production of sparks continues at this point until the gas-cock is nearly wide open, when the portion 15 of the cam is revolved past a shoulder, 17, on the lever *c'*, when the latter is instantly retracted by the spring 16 into the position seen in Fig. 1, with its lower extremity in contact with the points of both wires *b'* and *e'*, which closes the circuit at this point, when the resistance occasioned by the break at the point 14 will cause the current to resume the direct course, first described, through the lever *c'*.

This break in the circuit is produced in succession at each of the several lamps as soon as the lever *c'* is operated by the cam *i'*, which can only take place when the gas-valve is being opened, and, as these gas-valves are opened one at a time in succession, it is evident that but one break can occur at a time in the circuit which produces the sparks, viz., at the particular lamp being lighted; and, as the amount of resistance to the electric current occasioned by a single break is very slight, a current of very moderate power may be employed, thus avoiding the necessity of employing a thickly-coated wire to prevent the escape of the electricity, as has heretofore been necessary where a great number of breaks occur in the circuit; and even if a powerful current should be employed, when the resistance to be overcome is occasioned by a single break only, as above described, a conducting-wire having a very thin coating of insulating material may be employed without any liability of the escape of the electricity, and consequently a great saving may be effected in the cost of the conducting-wire.

The above-described apparatus is of simple construction, while its action is certain and reliable, and by its use much less powerful currents of electricity, and consequently less expensive conducting-wires, are required than with any other apparatus of this description heretofore employed.

Instead of providing each apparatus with a lever, *c'*, for the purpose of automatically breaking the circuit at each gas-burner in succession, the automatic circuit-breakers may be placed at intervals, so that the electric sparks will be produced at more than one burner at a time—say at two or three burners simultaneously—the aggregate resistance of these few breaks thus produced being easily overcome. I prefer, however, to produce a break at one burner only at a time, as first described.

What I claim as my invention, and desire to secure by letters patent, is—

1. The within-described method of operating gas-valves by means of a current of electricity passing alternately through separate wires,
in combination with the springs *k s* and cam *o*, or equivalent
163 device, for automatically breaking the circuit through the electro-magnet and causing the current to pass to the next apparatus, substantially as described.

2. Breaking and closing the electric lighting-circuit at any desired point, for the purpose of producing the sparks to ignite the gas, by

3 Sheets—Sh

F. BEAN.

Electric Gas Lighter and Extinguisher.

No. 108,434. Patented Oct. 18,

No. 232.
Electric Gas Lighting Co.
v.
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p. 169.

Fig. 3.

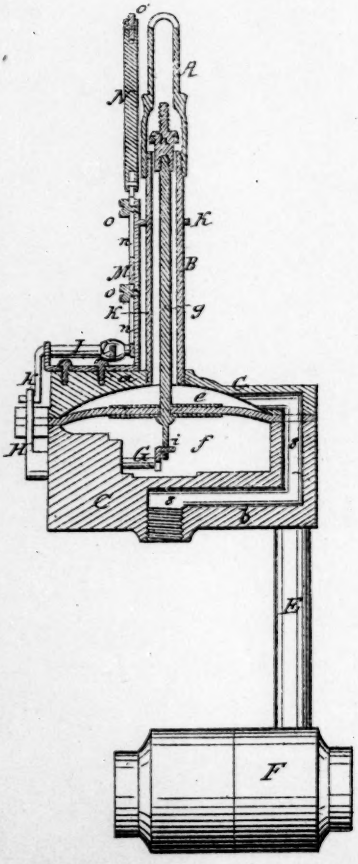


Fig. 4.

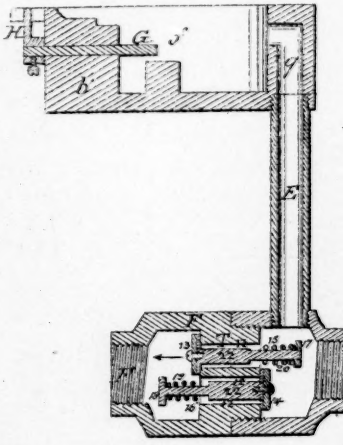
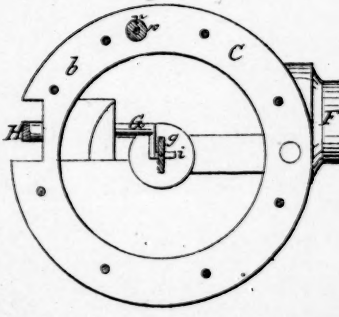


Fig. 5.



Witnesses.
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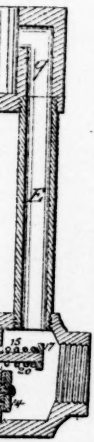

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3 Sheets—Sheet 2.

F. BEAN.

Electric Gas Lighter and Extinguisher.

No. 108,434. Patented Oct. 18, 1870.

Fig. 6.

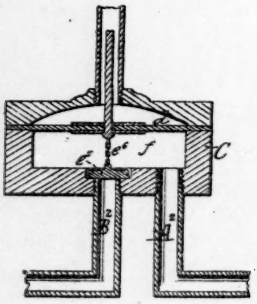
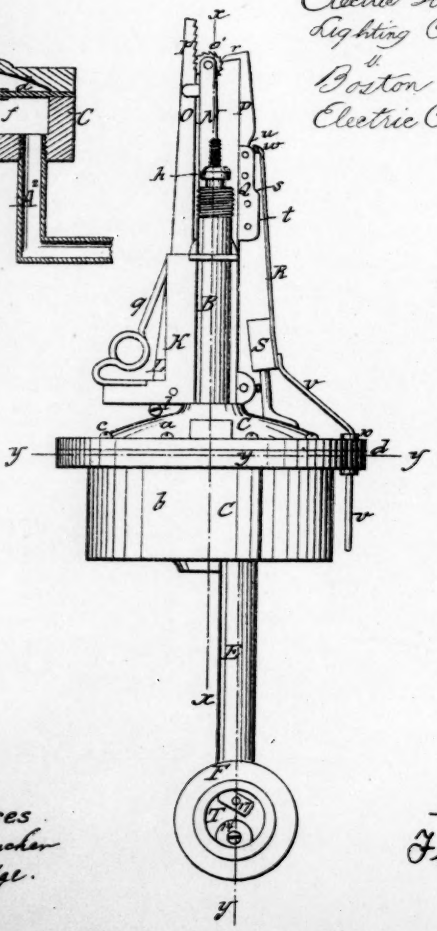


Fig. 2.



No. 232.
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v.
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p. 167.

Witnesses
J. C. Teschemacher
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Frank Bean.

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3 Sheets—Sheet 1.

F. BEAN.

Electric Gas Lighter and Extinguisher.

No. 108,434. Patented Oct. 18, 1870.

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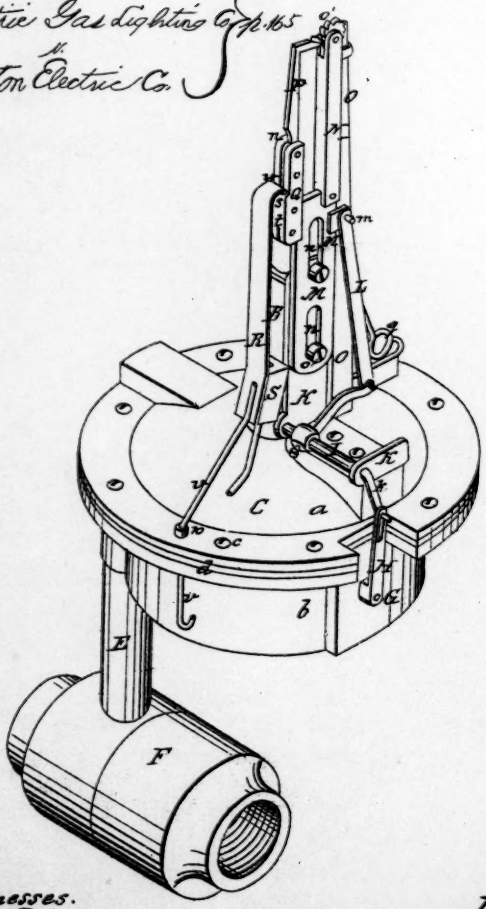
N. Boston Electric Co.

Fig. 1.



Witnesses.
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Inventor.
Frank Bean

means of the cam i' upon the shaft of the gas-cock operating the lever c' or their equivalents, substantially as described.

3. In combination with the mechanism by which the gas-valve is operated, the cam i' and lever c', or equivalent device, for breaking the electric lighting-circuit, so arranged that, as the gas-valve is opened, the sparks will be produced at the required point to ignite the gas, substantially as set forth.

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Witnesses:
P. E. TESCHEMACHER.
W. J. CAMBRIDGE.

170 UNITED STATES PATENT OFFICE.

FRANK BEAN, of Somerville, assignor to Edwin E. Bean, of Boston, Massachusetts.

Letters Patent No. 108,434, dated October 18, 1870.

Improvement in Apparatus for Lighting and Extinguishing Gas by Electricity.

The schedule referred to in these letters patent and making part of the same.

To all whom it may concern:

Be it known that I, Frank Bean, of Somerville, in the county of Middlesex and State of Massachusetts, have invented a pneumatic apparatus for lighting and extinguishing gas by electricity, of which the following is a full, clear, and exact description, reference being had to the accompanying drawing making part of this specification, in which—

(Here follow diagrams marked pp. 165, 167, & 169.)

Figure 1 is a perspective view, illustrating my invention.

Figure 2 is a rear elevation of the same, the gas-burner being removed and the position of some of the parts being changed.

Figure 3 is a longitudinal vertical section on the line $x\ x$ of Fig. 2.

Figure 4 is a vertical section on the line $y\ y$ of Fig. 2.

Figure 5 is a transverse section on the line $z\ z$ of Fig. 2.

Figure 6 is a modification, to be referred to.

To provide a means for immediately lighting and extinguishing gas-lamps, without the usual labor and expense attending the ordinary method of lighting and extinguishing each one by hand, is the object of my invention, which consists in operating the valves which control the admission of gas to the burners of a series of gas-pipes by pneumatic power, in combination with mechanism, also operated by pneumatic power, for making and breaking the electric circuit, to produce the sparks for igniting the gas in the series of burners, the exhaustion of the air serving to close the valves in the

burners, and, by cutting off their supply of gas, causing the lights to be extinguished as desired.

To enable others skilled in the art to understand and use my invention, I will proceed to describe the manner in which I have carried it out.

In the said drawing—

A is one of a series of gas-burners, screwed to the top of a short pipe, B, the lower end of which passes into a circular box or casing, C, secured to the top of a vertical gas-pipe, connected with the main supply-pipe, not shown.

This circular box is formed in two portions, *a b*, screwed together at *c*, and incloses a chamber, extended across, which is a flexible diaphragm, *d*, dividing it into two compartments, *e f*, with the former, *e*, of which the pipe supplying the gas communicates, through a passage, 8, while a vertical pipe, E, leading from a pipe, F (connected with an air-pump not shown), communicates with the compartment *f* through a passage, 9.

To the center of the diaphragm *d* is secured the bottom of a rod, *g*, which passes up through the center of the pipe B, and carries at its upper end a valve, *h*, which is raised from and lowered upon its seat at the top of the pipe B, to open and close the passage to the burner A.

Passing through the side of the casing, and into the interior of the compartment *f*, is a rocker-shaft, G, on the inner end of which is a crank or arm, *i*, to which is connected the slotted end of the rod *g*, which is secured to the diaphragm, and projects slightly below its lower surface for this purpose, and as the valve-rod *g* is raised or lowered by the movement of the diaphragm, the shaft G is rocked, and its motion communicated to mechanism now to be described.

The end of the rocker-shaft G outside the casing is provided with a slotted arm or crank, H, which moves a crank, *k*, on the outer end of another short rocker-shaft, I, which has its bearings in the foot of an upright frame or support K, through the upper end of which passes the pipe B.

From one side of the rocker-shaft I projects an arm, *l*, to the outer end of which is pivoted the lower end of a connecting-rod, L, the upper end of which is connected with a stud, *m*, extending out from a plate, M, which is provided with slots, *n*, through which screw-pins *o* pass into the frame or support K to guide it when moved up and down thereon.

Pivoted to one side of the top of the slotted plate M, and rising therefrom, is a vertical bar, N, in bearings, in the top of which is placed a toothed or ratchet wheel, *o'*, which engages (on one side) with a rack, *p*, on the upper end of a vertical post, O, the lower end of which is secured to the frame or support K, and is pressed constantly by a spring, *q*, against the ratchet-wheel *o'*, so as to insure its meshing with the rack *p*, and being constantly kept in contact with the pointed end *r* of the metallic bar P, which is secured, at its lower end, to the top of the slotted plate M, on the side opposite to that where the bar N is secured.

Q is a strip of ivory or other substance which is a non-conductor

of electricity, and incloses the opposite sides of the lower end of the metallic bar P, being snugly secured in contact therewith by rivets or otherwise.

The lower portion of this ivory strip is of greater width, and projects out so as to form a shoulder, *s*, from which point to a point, *t* (a short distance below), the edge of the bar P is covered by the ivory strip.

The metallic bar P is also provided with a notch, *u*, at a point just above the top of the ivory strip, which construction is for a purpose now to be explained.

171 To one of the poles of a battery is connected the lower end of a wire, *v*, which passes through a non-conductive or insulating substance, 10, set into the edge of the circular casing C, and leads upward, and is secured to the lower end of a flat spring, R, attached, to an insulating block S, the upper end of the spring R being provided with a projection, *w*, which (when the bar P is up to the extent of its traverse) is pressed by the force of the spring against the portion *s t* of the ivory strip, which covers the edge of the metallic bar P, thus preventing the electric current from passing up to the point *r* of the bar P, in contact with the ratchet-wheel *o'*, and thus preventing the production of the sparks which light the gas issuing from the burner.

The other pole of the battery is connected with the toothed wheel *o'* by any suitable conductor.

When, however, this bar descends, the projection *w* comes in contact with the exposed edge of the bar P, from *s* to *u*, and the current is not interrupted in its passage to the point *r* in contact with the ratchet-wheel *o'*, and as the wheel moves down on the rack *p*, and the teeth revolve under and temporarily pass from contact with the point *r* of the bar P, the sparks are produced which, on account of their proximity to the tip of the burner, ignite the gas issuing therefrom.

Just previous, however, to the completion of the descent of the bar P, the notch *u* reaches the projection *w*, when the contact between the later and the bar P is broken, and the force of the current will then be concentrated on the next burner of the series, as required.

It will be seen that the descent of the bars N and P serves to carry the wheel *o'* and point *r* down below the flame issuing from the burner, and they are thus prevented from being injured or destroyed thereby.

The methods heretofore employed for igniting gas by electricity have been either to employ an intense or induced current of electricity, which produced a series of sparks by leaping over a break or interruption in the conductor at the tip of the burner, or to pass a current of electricity through a small platinum wire (placed over the tip of the burner) until it became heated sufficiently to ignite the gas.

The first of these methods requires the conductor to be heavily coated, in order to secure the necessary insulation to prevent the escape of the electricity, while, when the platinum wire is employed,

it is difficult to regulate the force of the current, as an excess of electricity will melt the wire, while an insufficient current will not heat the wire enough to ignite the gas. An ordinary current of electricity will, however, produce a spark where the circuit is broken; and by the employment of a device for making and breaking the circuit in close proximity to the tip of the burner, as above described, I am enabled to employ an ordinary or comparatively feeble current of electricity for igniting the gas, instead of the induced current heretofore required to leap over the permanent break in the conductor at the tip of the burner, and a less perfectly insulated conductor may, consequently, be employed than heretofore.

The air-pipe F is provided with a series of pairs of valves, equal in number to the number of gas-lights used; and at each point where a vertical pipe, E, connects with the air-pipe is formed a partition or plug, T, provided with two circular passages, 11 12, see Fig. 4, which are opened and closed by two valves, 13 14, the rods 22 of which pass centrally through the passages in opposite directions, and through cleats 15 16, bridged over the ends of the passages opposite to those closed by the valves.

The outer ends of the valve-rods are provided with enlargements 17 18, and between these enlargements and the cleats 15 16, the valve-rods are surrounded by spiral springs 19 20, which serve to insure the valves being brought in contact with their seats until the force of the air pumped into the air-pipe F, and that caused by the exhaustion of air therefrom, is sufficient to overcome the tension of the springs 19 20, when the valves are removed from their seats and open the passages 11 12.

The strength of the spring 19 is just sufficient to keep the valve on its seat when air is not forced into the pipe to operate the valves of the burners and mechanism for lighting the same; but when the air is pumped in, and the valve of the burner and mechanism connected therewith has been operated, the pressure against the inner end of the valve 13 carries it, against the resistance of the spring 20, in the direction of the arrow 21, and pushes the valve 13 off from its seat, thus opening the passage 11, and allowing the air to be forced through the portion of the pipe beyond to open the valve *h*, which controls the admission of gas to the next burner, and simultaneously therewith bringing the wheel *o'* of the next burner down, so that, when revolving, its teeth will temporarily be brought out of contact with the point *r* of the metallic bar P, so as to produce a series of sparks, (in a manner heretofore described,) which ignite the gas flowing up the burner.

When it is desired to extinguish the series of gas-lights, it is simply necessary to exhaust air from the first section of the pipe F, when the valve *h*, through the connections already described, will be closed, shutting off the supply of gas to the burner, and the current of electricity will be interrupted in its passage to the toothed wheel *o'*; and almost simultaneously with the shutting off of the gas from one burner, the resistance of the spring 19 will be overcome, and the valve 14 will open communication with the passage 12 and portion of the pipe beyond, and the exhaustion of the air

therefrom will cause all of the burners to be extinguished as required.

The object of operating separately the valves controlling the admission of gas to the burners, is so that the electric current may be concentrated on one burner at a time, as, should it be acting simultaneously upon all of the burners of the series, it would require a separate conductor for each burner.

One valve may be arranged, as seen in Fig. 6, so as to accomplish the same result produced by the employment of the valves 13 14. In this case an air-pipe, A^2, communicates with the lower compartment *f* of the casing C, and another pipe, B^2, leads therefrom to the lower compartment *f* of the next apparatus, and so on throughout the series.

On the top of the pipe B^2 rests a valve, 25, which fits into a suitable recess, and is connected by a short chain, 26, with the diaphragm *d*. On the air being forced into the compartment *f*, through the pipe A^2, the diaphragm is raised, and with it the valve *h*, the length of the chain 26 being such that the valve 25 will not be raised until the valve *h* and mechanism connected therewith have been operated, and the air is thus caused to act upon the mechanism of one apparatus and then pass on to the next one in the series, in the same manner as when two valves are employed.

When the gas is to be extinguished the air is exhausted from the compartment *f* through the pipe A^2, when the diaphragm *d*, and with it the valve *h*, are drawn down, shutting off the supply of gas, after which the partial vacuum in the compartment *f* causes the valve 25 to be raised off its seat, opening communication with the pipe B^2, from which the air is then exhausted to extinguish the light of the next apparatus, and so on throughout the whole series.

Instead of a valve, 25, a stop-cock may be employed, so arranged as to be opened and closed by the movement of the diaphragm.

Claims.

What I claim as my invention, and desire to secure by letters patent, is—

172 1. A mechanism, connected with the valve which controls the admission of gas to the burner, and operated simultaneously therewith by pneumatic power, for making and breaking the electric circuit, and thereby producing sparks for igniting the gas, substantially as described.

2. In combination with the air-pipe or pipes, one or more valves, operated by pneumatic power, and so constructed and arranged as to allow the air to pass successively from one apparatus to another, substantially as described.

3. The toothed wheel O′ and the bar P, with its point *r*, or their equivalents, when applied to the burner A, for producing sparks during the passage of an electric current to ignite the gas, substantially as described.

4. The bar N with its wheel O′, and the bar P with its point *r*, when so arranged that they can be raised and lowered, as and for the purpose set forth.

5. The bar P, with its non-conducting strip Q, operated by pneumatic power, in combination with the spring R, for making and breaking the electric circuit at the required time, substantially as described.

6. A pneumatic apparatus for operating the valve which admits the gas to the burner, in combination with an electrical apparatus for igniting the gas, substantially as described.

Witness my hand and seal, this 6th day of August, A. D. 1870.

FRANK BEAN. [L. S.]

Witnesses:
N. W. STEARNS.
W. J. CAMBRIDGE.

176 UNITED STATES PATENT OFFICE.

WALTER J. MORRIS and WILLIAM J. REID, of New York, N. Y.

Letters Patent No. 101,491, dated April 5, 1870.

Improvement in Apparatus for Lighting Gas by Electricity.

The schedule referred to in these letters patent and making part of the same.

To all whom it may concern:

Be it known that we, Walter J. Morris and William J. Reid, of the city, county, and State of New York, have invented a new and improved device for lighting gas by electricity; and we do hereby declare that the following is a full, clear, and exact description thereof, which will enable others skilled in the art to make and use the same, reference being had to the accompanying drawing forming part of this specification, in which—

(Here follows diagram marked p. 175.)

Figure 1 is a side elevation, partly in section, of the apparatus for lighting gas by electricity.

Figure 2 is an end view of the same.

Figure 3 is a horizontal section of the same, taken on the plane of the line *y y*, Fig. 2.

Figure 4 is a detail side view of the main armature-lever.

Similar letters of reference indicate corresponding parts.

The object of this invention is to light a suitable number of gas-jets with a battery which is but little more powerful than would be required to light one, and overcome the resistance of the main conductor.

By the peculiar arrangement, the current never passes through more than one electro-magnet at a time.

Three electro-magnets A, B, and C are used in the apparatus, each having an independent conductor of electricity from the batter

MORRIS & RIED.

Electric Gas-Lighter.

No. 101,491. Patented April 5, 1870.

No. 232. Electric Gas lighting Co. v. Boston Electric Co. } p. 175

Fig. 1

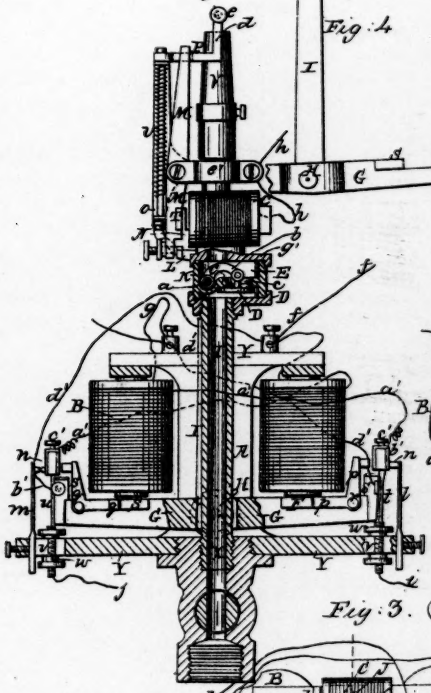


Fig. 4

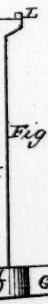


Fig. 2

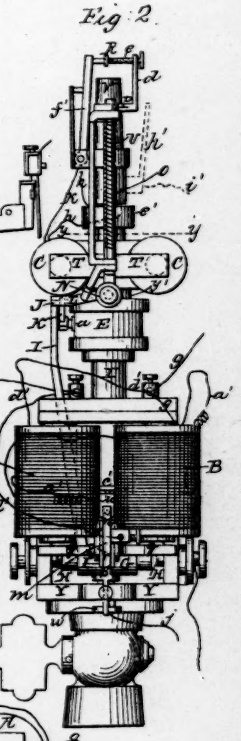
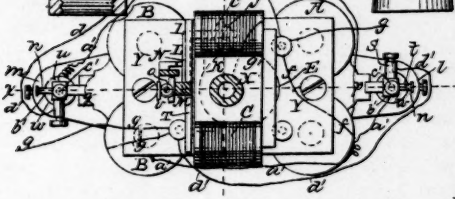


Fig. 3.



Witnesses

Inventors.
W. O. Morris
H. G. Ried
for Wm. & Co
Attorneys

and no two of the magnets or conductors are in contact with the battery at the same time.

The magnet A closes by means of an arm, I, of its armature-lever G, the valve D in a chamber E of the gas-pipe X.

When the magnet A is charged, it draws to itself the armature F, which is firmly secured to the lever G pivoted at the point H to the frame Y of the apparatus.

The lever G is in a horizontal position and has a vertical arm, I, with a fork at its upper extremity, in which rests the pin J of the valve-crank K, which, through the medium of its arbor, *a*, and inner lever, *b*, raises the valve D to its seat, *c*, in the gas-pipe, the pressure of gas being under the valve, and holding it closed.

The lever I has at its upper end a horizontal arm, L, which moves, as the valve is being closed, the armature-lever M away from the magnet C, by striking against the lower end of the said lever M.

The arm L also strikes a small lever, N, which is secured to an upright swivel-rod, O.

To the upper end of the swivel-rod O is secured another small lever, P, which has a vertical arm, *d*, carrying a horizontal pin, *e*, that is tipped with platina.

By the aforesaid motion of the arm L, the rod O is turned until platina tip comes in contact with a corresponding stationary tip, R. The upper end of the armature-lever M catches then behind a shoulder of the lever P, and locks the tips *e* R together.

In like manner the electro-magnet B, when excited, draws the armature S at the other end of the lever G, moving thereby the lever G I in a direction opposite to that caused by the magnet A, and forces the valve D off its seat, permitting the gas to flow into the burner V, above which the points *e* R are held in contact. The arm L of the lever I is removed from the upper armature-lever M and small lever N, so that, when the magnet C is charged, the lever M is free to move toward its magnet.

The magnet C draws, when excited, the armature T on the lever M to itself, moving the lever M and releasing the lever P, liberating thereby a spring, U, by which the rod O is turned, so as to sever the connection of the platina tips *e* R. By this disconnection, a spark is produced at the instant of separation, sufficiently powerful to light the gas issuing from the burner V.

As each of the magnets A, B, C is worked through separate conductors, the battery may be turned by a switch to the magnet B, which opens the valve, and when the gas has driven the air from the tube, the magnet C may receive the current, which will light the gas; and, when it is desirable to extinguish the light, the current should be turned to the magnet A, which closes the valve and arranges the levers of the magnet C for a fresh operation.

The connections for the electro-current are so arranged that, after a magnet has done its work of opening or closing a valve, or lighting the jet, it is itself thrown out of the circuit, and the connection transferred from the ground to the main conductor beyond, and which leads to the next instrument.

The wires *f g h* lead from the battery, or, more properly, from the switch, and connect with the magnets A, B, and C, respectively.

The wires *i j i'* are the main conductors to the next instrument.

l m are springs, secured in the frame opposite the ends of the lever G, and provided with platina tips *n n*. They have a metallic connection with the ground, through the frame and gas-pipe.

Each of the magnets A and B is provided with additional armatures, *p q*, which are placed in the same plane as the main armatures F S, but pivoted in the main lever G at the points *r r*.

To each end of the lever G is secured an upright insulating-arm, *s*, as shown.

The main conductors *i* and *j* are respectively connected with springs *t u*, which are held between the spring *l m* and the outer arms of the additional armatures *p q*.

177 The springs *t u* are insulated from the frame by the blocks *v*, and are made vertically adjustable by screws, *w w*.

Hooks or catches on the inner faces of the springs *t u* slip over the block *s* at the ends of the lever G, when such ends are at their maximum distance from their magnets, and the catches therefore hold the lever securely in that position, thus securing the valve D open or closed, as the case may be.

In the drawing the valve is represented as closed, and the catch *u* is shown as having slipped over the block *s* of the lever G, while the other catch, *t*, is thrown back by the other block, *s*.

The catches can again be released or tripped by the armatures *p* and *q* through their levers; for if the magnet B should become excited in the position shown in the drawing, the catch *u* prevents the lever G from moving toward B. But the armature *q* is drawn to the magnet, and its lever trips the catch *u*, and thus relieves the lever G. This condition alternates from one end of the lever to the other, as the valve is opened or closed.

In the drawings, the connections are arranged for the magnet B. The current from the wire *g* passes through the magnet B, and is led by the wire *a'* to a platina point, *b'*, which is insulated on the pawl *t*, and held in place by means of a screw, *i*. The platina point *b'* is in contact with the tip *n*, of the ground-connection spring *l*. When the magnet B is excited, the lever G is moved, and the catch *t* slips over the end of the block *s*, breaking the connection at *n*, thus stopping the flow of the current through the magnet B.

But a wire, *d'*, leads from the main battery wire *g* to a metallic point on *s*, against which the catch *t*, which is part of the main conductor *i*, rests; so the current, no longer passing through the magnet B, passes through the main conductor *i* to the next instrument. This arrangement of connection is shown for the magnet A, and need not be further described. It will be seen that, when either of the magnets A or B has been used, the current cannot again be passed through it until the other has arranged its connections.

The magnet C is connected with the battery by means of the wire *h*, secured to a clamp, *e'*, which is insulated from the gas-pipe.

The current passes up through the frame-work to the lever P and

its platina tip *e* to the similar platina tip R, down its holder *f'* through the wire *k* to the magnet C.

A wire, *g'*, from the magnet C, connects with the ground by means of the gas-pipe. The circuit being complete through the magnet, it is charged and draws the armature T to itself, which, moving the lever M, releases the small lever P, which, drawn by the spiral spring U, separates the connection of *e* and R, which stops the flow of electricity through the magnet, at the same time lighting the gas.

The lever P moves back and strikes an arm, *h'*, which, forming part of the main conductor *i'*, is insulated from the apparatus, and the current passes directly to the next instrument.

It will be seen that the next instrument does not receive the current until the lever P moves, severs its connection *e* R, and forms the connection at *h'*. The separation of the points *e* R induces a spark sufficient to light the gas.

Having thus described our invention,

We claim as new, and desire to secure by letters patent—

1. The arrangement of the three magnets A, B, and C, on a gas-lighting apparatus, so that all are operated by one battery, but separately, substantially as described, and for the purpose set forth.

2. The magnet A, arranged on the gas-lighting apparatus, to close the valve in the gas-pipe, as set forth.

3. The magnet B, arranged on a gas-lighting apparatus to open the valve in the gas-pipe, as set forth.

4. The magnet C, arranged to operate, by the combined action of its armature and of the spring U, the platina tips *e* R, which produce the sparks, as specified.

5. The apparatus, arranged substantially as described, to apply the full power of the battery, less resistance of the conductors upon each instrument, and upon only one until its duty is performed, the currents then passing to the next instrument, and not passing through more than one magnet at a time.

6. The wires and springs so arranged as to form the electric connections, and retain them until the armatures have completed their full strokes, and then breaking them suddenly and completely, substantially as described, and for the purpose set forth.

7. The spring catches *t u* and additional armatures *p q*, so arranged as to lock the main armature-lever, as set forth.

The above specification of our invention signed by us this 28th day of April, 1869, and 23d day of November, 1869.

WALTER J. MORRIS.
WM. J. REID.

Witnesses for Morris:
FRANK BLOCKLEY.
WM. DEAN OVERELL.

Witnesses for Reid:
L. W. BARTLETT.
E. G. BURNHAM.

184 UNITED STATES PATENT OFFICE.

JACOB P. TIRRELL, of Charlestown, assignor to George F. Pinkham, of Boston, Massachusetts.

Improvement in Apparatus for Lighting and Extinguishing Gas by Electricity.

Specification forming part of Letters Patent No. 121,301, dated November 28, 1871; antedated November 17, 1871.

To all whom it may concern:

Be it known that I, Jacob P. Tirrell, of Charlestown, in the county of Middlesex and State of Massachusetts, have invented certain improvements in apparatus for lighting and extinguishing gas by electricity, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, making part of this specification, in which—

(Here follow diagrams marked pp. 179, 181, 183.)

Figure 1 is a front elevation of my improved apparatus. Fig. 2 is an elevation of one side of the same. Fig. 3 is an elevation of the opposite side. Fig. 4 is a vertical section on the line *x x* of Fig. 1. Fig. 5 is a vertical section on the line *y y* of Fig. 6. Fig. 6 is an elevation of a cylinder and parts connected therewith, to be hereinafter described. Fig. 7 represents the surface of the cylinder developed. Fig. 8 represents the cover or casing which incloses the apparatus.

My invention relates to that class of apparatus in which two sets of wires are employed alternately, one for letting on and the other for shutting off the gas; and it consists in the peculiar construction of the mechanism by which the gas is let on and shut off and the electric current caused to pass to the next apparatus, one apparatus only at a time being included in the electric circuit; and my invention also consists in the application to an electrical apparatus for lighting and extinguishing gas of a circuit-breaker operated by the armature of the electro-magnet and placed in close proximity thereto, whereby the armature is set in motion by the electric current without the employment of a key or clock-work mechanism at the central station, as has heretofore been required; and my invention also consists in the combination of an auxiliary burner with the main burner and an electric spark-generating mechanism, by which construction I am enabled to permanently place the spark-generating mechanism out of the reach of the flame issuing from the main burner; and my invention furthermore consists in arranging the primary coils for producing the sparks within the apparatus and in close proximity to the burner, which facilitates the construction of the apparatus and lessens its cost.

To enable others skilled in the art to understand and use my in-

3 Sheets—Sheet 1.

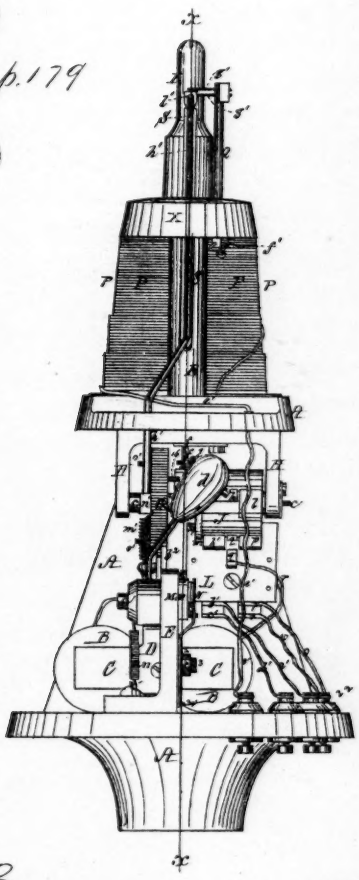
J. P. TIRRELL.

Apparatus for Lighting and Extinguishing Gas by Electricity.

No. 121,301. Patented Nov. 28, 1871.

No. 232. Electric Gas Lighting Co. v. Boston Electric Co. } p. 179

Fig. 1.



Witnesses,
P. C. Sturtevant
W. J. Cambridge

Inventor,
Jacob P. Tirrell

3 Sheets—Sheet 2.

J. P. TIRRELL.

Apparatus for Lighting and Extinguishing Gas by Electricity.

No. 121,301. Patented Nov. 28, 1871.

No. 232. Electric Gas Lighting Co. v. Boston Electric Co. } p. 181

Fig. 2.

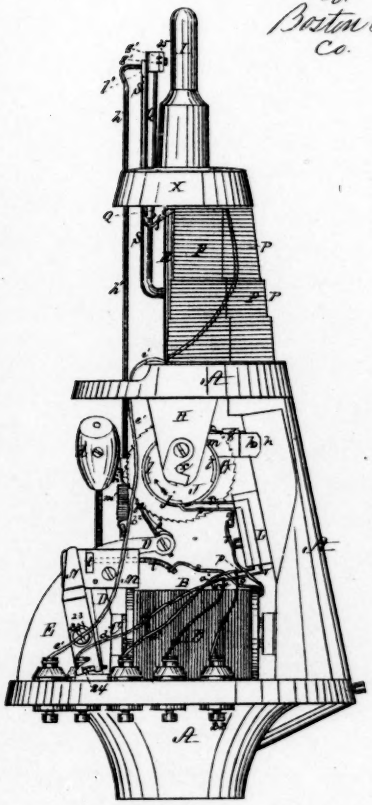
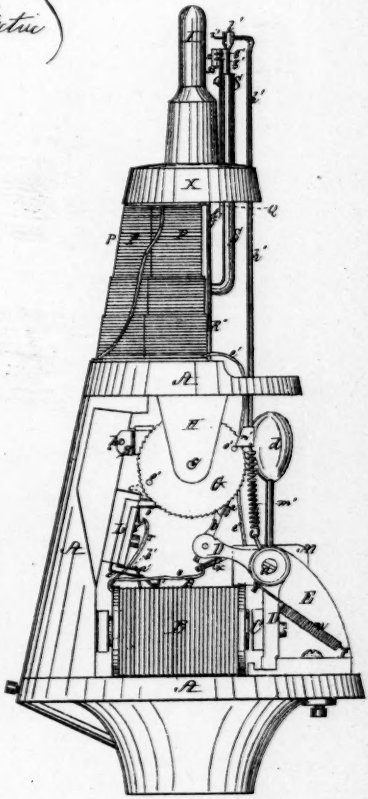
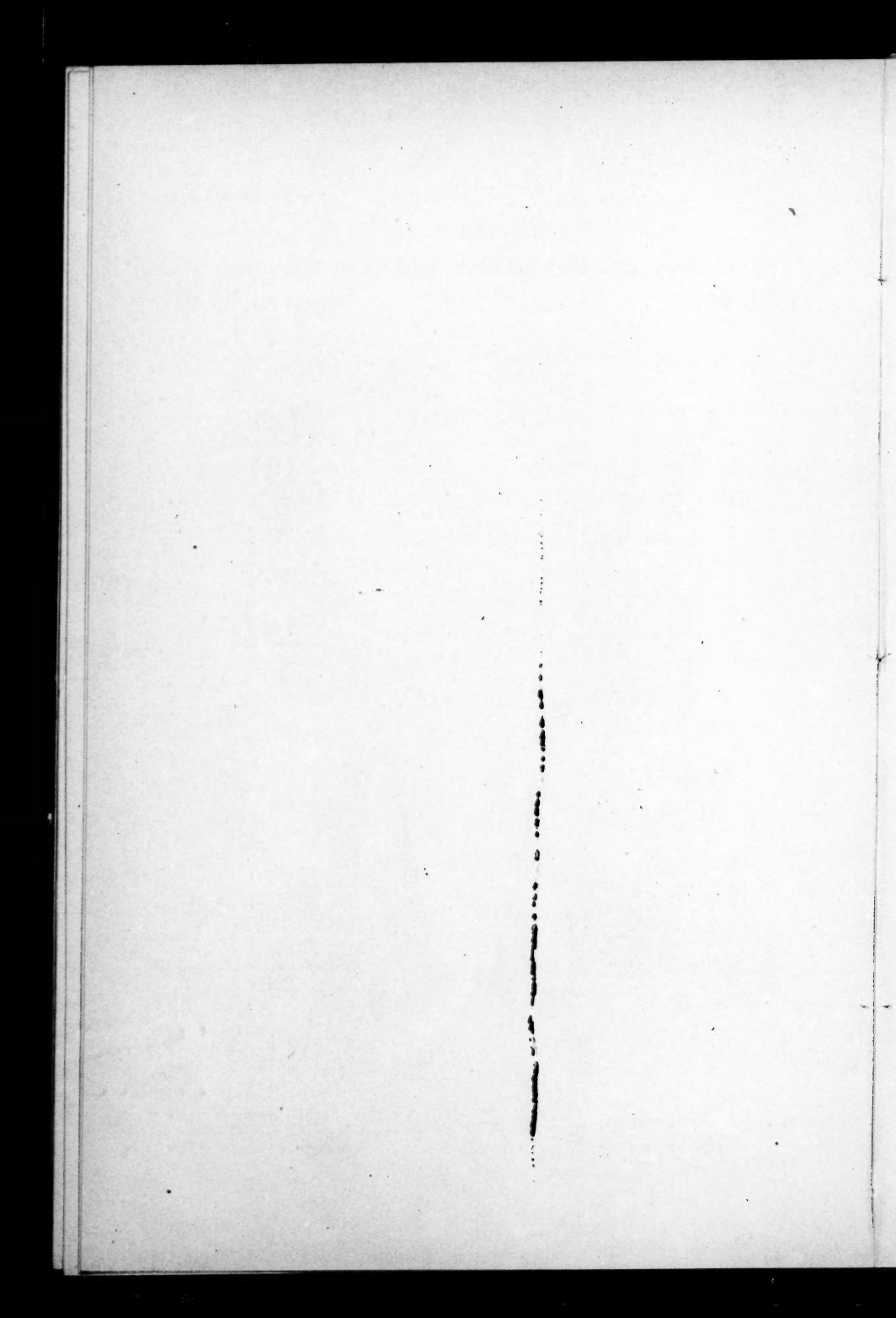


Fig. 3.



Witnesses,
R. Ewbankmacher
W. J. Cambridge

Inventor,
Jacob P. Tirrell



3 Sheets—Sheet 3.

J. P. TIRRELL.

Apparatus for Lighting and Extinguishing Gas by Electricity.

No. 121,301. No. 232. Electric G. L. C. } p. 183 " Boston Electric Co. } Patented Nov. 28, 1871.

Fig. 4.

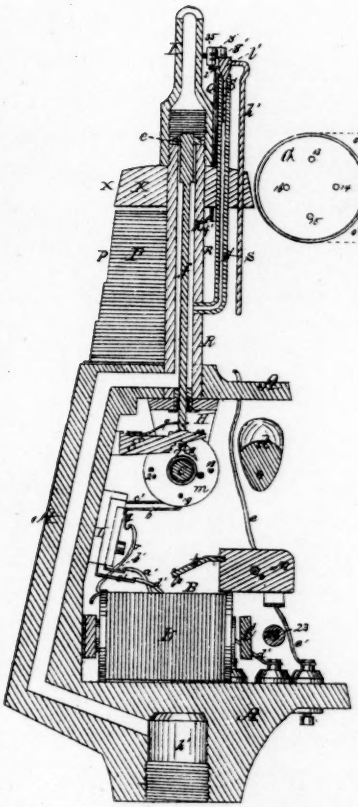


Fig. 5.

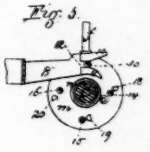


Fig. 6.

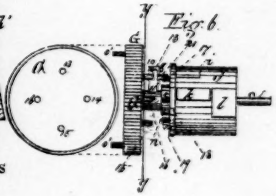


Fig. 7.

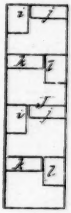
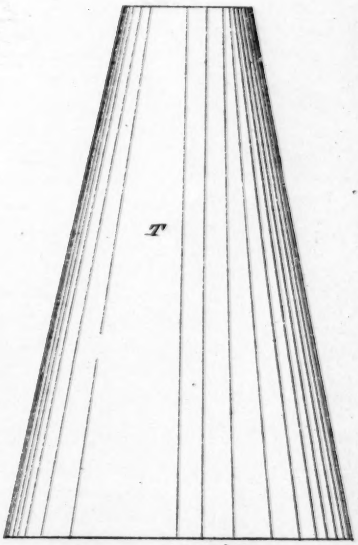


Fig. 8.



Witnesses,
W. J. Cambridge

Inventor,
Jacob P. Tirrell

vention, I will proceed to describe the manner in which I have carried it out.

In the said drawings, A represents the frame-work of the apparatus, to the lower portion of which is secured the electro-magnet B, the armature C of which is secured to the end of a bent lever, D, which is pivoted at *a* to a standard, E, and has pivoted to its upper end a pawl, *b*, which engages with the teeth of a ratchet-wheel, G, the shaft *c* of which revolves in bearings in a bifurcated support, H, secured to the upper portion of the frame-work. The ratchet-wheel G, after being moved by the pawl *b*, is held by a retaining pawl or spring, b^2. *d* is a counterpoise-weight attached to a rod projecting up from the lever D. *e* is the valve through which the gas is admitted to the burner I, the lower end of the stem *f* of this valve being connected by means of a spring, 9, with a lever, *g*, which is pivoted to the frame-work at *h*, and is provided at its outer end with inclined jaws 10 11 and a groove, 12, Fig. 5. This lever is alternately raised and lowered to open and close the valve *e* by a series of pins, 13 14 15 16, which project from one side of the ratchet-wheel G and act alternately on the inclined sides of the jaws, the pins 13 15, which come in contact with the upper jaw, 10, being farther from the center of the wheel than the pins 14 16, which act on the lower jaw, 11, while each pin passes through the groove 12 in the lever as the wheel G revolves. The spring-connection 9 is for the purpose of insuring the tight closing of the valve *e* as the lever *g* is carried down. J is a cylinder of hard rubber or other non-conducting material, which is supported upon the shaft *c* and turns independently thereof. This cylinder has let into its surface, so as to lie flush therewith, four pairs of metallic plates, *i j k l*, *i j k l*, each pair extending lengthwise across the cylinder, while the distance between the line passing through the center of the narrow plate of one pair and that passing through the center of the narrow plate of the next pair is equal to one-fourth of the circumference of the cylinder. The two plates of a pair are separated a short distance from each other, as seen in Figs. 1, 6, and 7, so as to be perfectly
185 insulated. To one end of the cylinder J is secured a circular plate, *m*, to a pin projecting from which is secured one end of a flat coiled spring, *n*, the other end of which is attached to the shaft *c*. 17 18 19 20 are four pins projecting from the plate *m*, the pins 17 19 being nearer the center than the pins 18 20, so that one of these four pins will always be in contact with a stop-pin, 21, Fig. 6, projecting from the lever *g*, when the latter is raised or depressed to its full extent. The cylinder is thus held stationary while the ratchet-wheel is being turned, and the shaft *c* as it revolves thus winds up the spring until the movement of the lever carries the stop 21 away from the pin resting against it, when the cylinder is instantly revolved a quarter-way round by the recoil of the spring *n*, the movement of the cylinder being stopped by the next pin coming in contact with the stop 21 on the lever *g*. The cylinder is thus carried round one-quarter of a revolution each time the lever *g* is raised or depressed, for a purpose that will be described hereinafter.

I will now proceed to describe the manner in which the electric

current is caused to pass through the apparatus for the purpose of rotating the ratchet-wheel G to let on and shut off the gas at the required times. The parts being in the position seen in Fig 1 (the gas being shut off), the electric current enters the apparatus at 22 and passes by the wire *o* to a flat spring, *p*, the rear portion of which is embedded in the insulating-block L. The upper portion of the spring *p* bears against one of the narrow metal plates *j* of the cylinder J, and against this plate *j* also bears another narrow spring, *q*, a part of which is also embedded in the block L. The current now passes by the spring *q* to a wire, *r*, connected with the electro-magnet B, after passing through which the current is conducted, by a wire, *s*, to a metallic piece, *t*, set in an insulating-block, M; thence to the upper end of a lever, N, with which it is in contact; thence to the frame-work, and by the gas-pipe or ground back to the battery, when the circuit is completed and the armature C is attracted by the magnet. The lever N is pivoted at 23 to the frame-work, and at its lower end is a notch, into which fits a bent wire, 24, projecting from the lever D, and thus, as the armature is drawn up against the magnet, the lever N is vibrated, which throws its upper end out of contact with the piece *t* and breaks the electric circuit. As soon as this takes place the armature ceases to be attracted, and is drawn back by its spring *u* into the position seen in Fig. 3, when the circuit is again completed and the operation is repeated as before. The armature C is thus set in motion by the electric current without the employment of a key or clock-work mechanism at the central station, as has heretofore been required. This motion of the armature C and its lever D vibrates the pawl *b*, which thus turns the ratchet-wheel G, the motion of which is instantly arrested as soon as it has completed a quarter of a revolution (which opens the gas-valve *e* to its full extent) by the movement of the cylinder J, which is at that instant released and revolved a quarter-turn, as above described. This quarter revolution of the cylinder J carries the narrow plate *j* out of contact with the spring *p*, and brings the wide plate *l* of the next pair into contact therewith, the narrow spring *q* being at the same time brought into contact with the other plate, *k*, of the same pair. The current cannot now pass from the spring *p* to the spring *q*, as the plates *k l* are insulated from each other, and the circuit through the electro-magnet is thus broken and the motion of the ratchet-wheel G arrested. The current then passes from the spring *p*, through the wide plate *l*, to another spring, *v*, which is also embedded in the block L, and thence by the wire *w* to the next apparatus, where the same operation is repeated, and so on throughout the whole series of lamps, one apparatus only being included within the circuit at a time, the electric current passing from one to another in succession until it has passed through the entire series, the gas-valve *e* of each apparatus being left in the exact position required when the motion of the wheel G is arrested by the automatic breaking of the circuit caused by the movement of the cylinder J. As soon as the gas is let on it is ignited by the electric sparks, in a manner which will be fully described hereinafter. The armature C cannot again be set in motion (when it is desired to shut

off the gas) by a current passing through the wire *o*, on account of the circuit having been broken, as above described. Another wire, *a'*, is therefore employed, through which the electric current passes to a flat spring, b^1, the rear portion of which is embedded in the insulating-block L. The upper portion of this spring b^1 bears against one of the narrow metal plates *k* of the cylinder J, and, as the spring *q* is also at this time in contact with the plate *k*, the current passes by the wire *r* to the electro-magnet B and back to the battery, as before. This again sets the armature C in motion and rotates the wheel G for the purpose of closing the valve *e* and extinguishing the gas. As soon as the wheel G has completed a quarter-revolution (which completely closes the valve *e*) the cylinder J is released and revolved a quarter-revolution, which carries the plate *k* out of contact with the spring b^1 and brings the wide plate *i* of the next pair into contact therewith, the spring *q* being at the same time brought into contact with the other plate, *j*. The current cannot now pass from the spring b^1 to the spring *q*, as the plates *i j* are insulated from each other and the circuit through the magnet is thus broken and the motion of the ratchet-wheel arrested. The current then passes from the spring b^1, through the wide plate *i*, to another spring, *c'*, which is also embedded in the block L, and thence by the wire *d'* to the next apparatus, where the same operation is repeated, the current passing successively from
186 one apparatus to another until all of the lamps are extinguished. The narrow plate *j* is thus left in contact with both of the springs *p q*, so that the armature C may be again set in motion to open the valve *e* by the current passing through the wire *o*, as before described. It will thus be seen that the arrangement of the plates on the cylinder J is such that as the latter is operated the breaking of the circuit through the wire *o* and electro-magnet B will not only cause the current to pass onto the next apparatus, but will leave the electro-magnet B connected with the other wire, *a'*, through which a current may be transmitted at the required time, while the breaking of the circuit through the wire *a'* and electro-magnet B will cause the current to pass onto the next apparatus, and at the same time leave the electro-magnet connected with the wire *o*, the wires *o a'* being thus used alternately, one to carry the current for opening the gas-valve and the other the current for closing it, the electro-magnet being at all times connected with one or the other of the wires *o a'*. The electric current which produces the sparks for lighting the gas passes from one pole of the battery by the wire *e'* to the primary coils P, which are placed near the top of the apparatus. I place the primary coils P for producing the sparks in close proximity to the burner, as it facilitates the construction of the apparatus and renders it less expensive than where these coils are placed beneath the lamp-post, as heretofore. After passing through the coils P the current passes by the wire *f'* to the insulated rod or post Q, to the upper end of which are secured two light springs, *g' g'*. The other pole of the battery is connected through the frame-work A with a sliding-rod, *h'*, near the upper end of which is a pin, *i'*, which is raised and lowered in a manner to be presently described, and

thus, when the contact between the pin *i'* and springs *g' g'* is made and broken, as the rod *h'* is raised, the sparks are produced as required. The springs *g' g'* are held in place by a small plate, 35, secured to the post Q by a screw, so that they can be adjusted or replaced at small cost when worn or burnt out. The gas is admitted to the apparatus at *k'* and passes up through a passage formed in the frame-work A to the pipe R, to which the burner I is attached. The pipe R is surrounded near its upper end by an insulating-disk, X. Connected with the pipe R, below the valve *e*, is an auxiliary burner, S, the small orifice at the top of which is closed by a valve, *l'*, attached to the upper end of the rod *h'*, and this valve is kept closed down upon its seat by a spring, *m'*, attached to the lever D, and a block, *n'*, at the lower end of the rod *h'*. *o' o'* are two pins projecting from the side of the ratchet-wheel G, which are brought into contact with the block *n'*, when, as the wheel G revolves, the rod *h'* is raised so as to open the valve *l'* and allow the gas to escape from the auxiliary burner, which is instantly lighted by the sparks produced by the contact between the pin *i'* and springs *g' g'* being made and broken as the rod *h'* is raised. The orifice through which the gas escapes from the auxiliary burner is on one side only of the valve *l'*—viz., on the side to which the pin *i'* is attached—so that the gas as it escapes will flow directly up to the point where the sparks are produced, which renders it more certain to be lighted. As soon as the auxiliary burner is lighted the valve *e* commences to open, and the gas issuing from the main burner I is instantly ignited from the flame of the auxiliary burner. The pin *o'* now passes out of contact with the block *n'*, when the rod *h'* is drawn down by the spring *m'*, closing the valve *l'* and extinguishing the auxiliary jet.

By the employment of an auxiliary burner I am enabled to permanently place that portion of the apparatus where the sparks are produced out of the reach of the flame issuing from the burner I, and thus avoid the necessity of employing mechanism to raise the whole spark-producing apparatus up to the orifice of the main burner and then lower it, as has heretofore been necessary to prevent it from being injured or destroyed by the flame. Another advantage resulting from the use of an auxiliary burner is that the small jet of gas issuing from it is more readily ignited by the electric spark than a large jet—consequently it is more certain to be lighted.

It will be seen that with the above-described apparatus a quarter of a revolution only of the wheel G is required to open or close the gas-valve *e*, instead of a half-revolution, as heretofore, and a saving of time is thereby effected, while the action of the apparatus is certain and reliable.

The apparatus is surrounded by a conical sheet-metal cover or casing, T, Fig. 8, which serves to exclude dust and moisture.

What I claim as my invention, and desire to secure by letters patent, is—

1. The within-described mechanism for automatically breaking the circuit through the electro-magnet and causing the current to pass to the next apparatus, the said mechanism consisting, essentially, of the ratchet-wheel G, operated by the electro-magnet, in

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3 Sheets—Sheet 3.

J. P. TIRRELL.

Apparatus for Lighting and Extinguishing Gas by Electricity.

No. 121,302. Patented Nov. 28, 1871.

No. 232. Electric L. & P. Co. vs. Boston Electric Co. p. 193

Fig. 5.

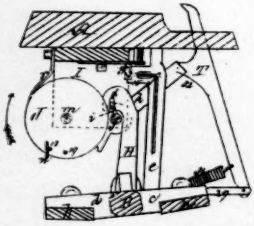

Fig. 8.

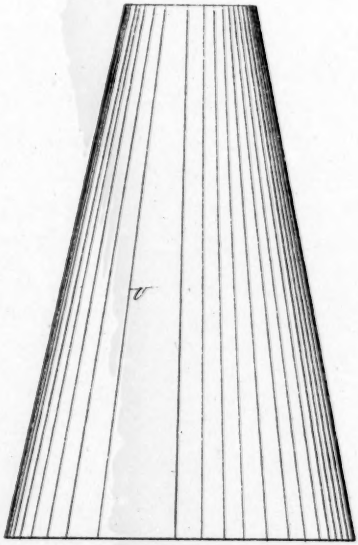

Fig. 6.

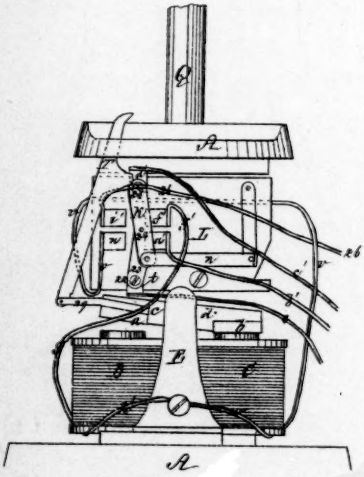

Fig. 7.

Fig. 9

Witnesses,
P. G. Lesslemacher
W. J. Cambridge

Inventor,
Jacob P. Tirrell

191

3 Sheets—Sheet 2.

J. P. TIRRELL.

Apparatus for Lighting and Extinguishing Gas by Electricity.

No. 121,302. Patented Nov. 28, 1871.

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Boston E. Co

Fig. 3.

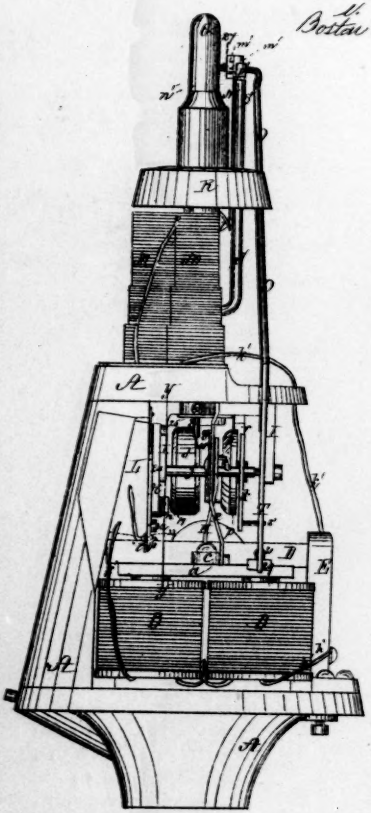
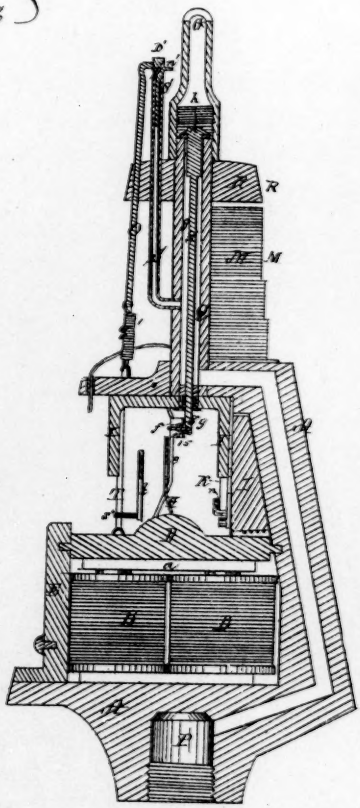


Fig. 4.



Witnesses,
P. B. Taylor
W. J. Cambridge

Inventor,
Jacob P. Tirrell

3 Sheets—Sheet 1.

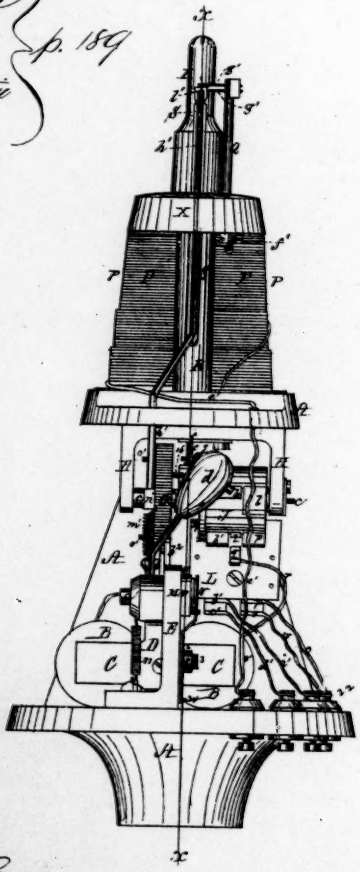
J. P. TIRRELL.

Apparatus for Lighting and Extinguishing Gas by Electricity.

No. 121,301. Patented Nov. 28, 1871.

No. 232.
Electric Gas
Lighting Co.
v.
Boston Electric
Co.
} p. 189

Fig. 1.



Witnesses,
[illegible]
W. J. Cambridge

Inventor,
Jacob P. Tirrell

combination with the shaft *c*, lever *g*, cylinder J, with its insulated plates, and the springs *p q v* b^1 *c'*, and wires connected therewith, operating substantially as set forth.

2. The ratchet-wheel G, with its pins 13 14 15 16, in combination with the lever *g* for operating the gas-valve *e*, substantially as described.

3. In an electrical apparatus for lighting and extinguishing gas, the circuit-breaker N, operated by the armature of the electro-magnet and placed in close proximity thereto, substantially as and for the purpose set forth.

4. The combination of an auxiliary burner, S, with the main burner I and an electric spark-generating mechanism, substantially as and for the purpose described.

187 5. The arrangement of the primary coils P within the apparatus and in close proximity to the burner, substantially as and for the purpose set forth.

6. One or more springs, *g' g'*, attached to the insulated post Q, and connected with one pole of the battery, in combination with the pin *i'*, connected with the opposite pole of the battery for producing the sparks, substantially as described.

7. The rod *h'*, in combination with the valve *l'*, auxiliary burner S, pin *i'* and one or more springs, *g' g'*, operating substantially as described.

Witness my hand this 26th day of April, A. D. 1871.

JACOB P. TIRRELL.

Witnesses:

P. E. TESCHEMACHER.

W. J. CAMBRIDGE.

194 UNITED STATES PATENT OFFICE.

JACOB P. TIRRELL, of Charlestown, assignor to George F. Pinkham, of Boston, Massachusetts.

Improvement in Apparatus for Lighting and Extinguishing Gas by Electricity.

Specification forming part of Letters Patent No. 121,302, dated November 28, 1871; antedated November 17, 1871.

To all whom it may concern:

Be it known that I, Jacob P. Tirrell, of Charlestown, in the county of Middlesex and State of Massachusetts, have invented certain improvements in apparatus for lighting and extinguishing gas by electricity, of which the following is a full, clear, and exact description, reference being had to the accompanying drawing, making part of this specification, in which—

(Here follow diagrams marked pp. 189, 191, 193.)

Figure 1 is a front elevation of my improved apparatus. Fig. 2 is an elevation on one side of the same. Fig. 3 is an elevation of the opposite side. Fig. 4 is a vertical section on the line *x x* of Fig. 1. Fig. 5 is a vertical section on the line *y y* of Fig. 3. Fig. 6 is an elevation illustrating the course of the electric currents. Fig. 7 is rear elevation of the switch. Fig. 8 represents the cover or casing which incloses the apparatus; Fig. 9, sectional detail.

My invention relates to that class of apparatus in which two separate wires are employed alternately, one for letting on and the other for shutting off the gas; and consists in the employment of two electro-magnets, operated alternately, in combination with a mechanism connected therewith for letting on and shutting off the gas, and operating a switch or equivalent device for breaking the circuit through either one of the electro-magnets and causing the current to pass to the next apparatus, one apparatus only at a time being included in the electric circuit; and my invention also consists in certain details, which will be fully described hereafter.

To enable others skilled in the art to understand and use my invention I will proceed to describe the manner in which I have carried it out.

In the said drawing, A represents the frame-work of the apparatus, to the lower portion of which are secured two electro-magnets, B C, the armatures *a b* of which are secured to two arms, *c d*, projecting from opposite sides of a rock-shaft, D, having its bearings in the frame-work and a standard, E. To the arm *c* is pivoted a bar or connecting-rod, *e*, near the upper end of which is a projection, 15, which is secured by means of a spring connection, *f*, to the lower end of the stem *g* of the valve *h*, through which the gas is admitted to the burner G. The upper end of the bar *e* fits into and slides within a recess in the frame-work which serves as a guide, and this bar *e* is alternately raised and lowered, to open and close the valve by the shaft D, which is rocked as the armatures *a b* are alternately attracted by their respective electro-magnets. The spring connection *f* is for the purpose of insuring the tight closing of the valve *h* as the bar *e* is drawn down. From the upper side of the rock-shaft D projects an arm, H, the upper portion of which is provided with an open slot, 16, in which fits the horizontal portion of a pin, *i*, both ends of which are secured to a rock-shaft, *j*, having its bearings in a support or hanger, I, and thus as the shaft D is rocked its motion is communicated to the shaft *j*. To this latter shaft is secured a lever, *k*, at one end of which is a toothed segment, 17, which engages with a pinion, *l*, on a shaft, *m*, which also has its bearings in the support I. To this shaft is permanently secured a balance-wheel, J, from the inner face of which projects two pins, 18 19, which, when the wheel is rotated back and forth through the connections described, strike alternately against the opposite sides of a projection on the end of a slide, *n*, attached to a switch, K, which is thus moved forward and backward at the required times for a purpose to be hereafter described.

In order to prevent any recoil of the wheel J after either of its pins have been brought into contact with the slide *n*, which would

prevent the complete shutting off of the gas, I employ the following device: *p* is a wheel, turning loosely upon the shaft *m* and held thereon by a friction-clutch, *q*, Figs. 2 and 9, composed of a bent spring, secured to a pin projecting from the side of the wheel *p*, the two ends of the spring embracing the shaft *m*, and the desired amount of friction being produced by turning a screw, 20. *r* is a spring, which bears upon the periphery of the wheel *p* and serves as a brake to prevent the mechanism from being moved by the tendency of the wheel J to recoil, or the force exerted by the spring connection *f* when the stem of the valve *h* is drawn down. By means of this device, when the motion of the wheel J is suddenly arrested by one of its pins coming into contact with the slide *n*,
195 the wheel *p*, by its momentum, overcomes the resistance of the friction-clutch *q* and turns upon the shaft *m*, and, being connected therewith by the clutch *q* and provided with the brake *r*, serves to effectually prevent the wheel J from recoiling as it would otherwise do when suddenly stopped.

I will now proceed to describe the manner in which the electric current is caused to pass through the apparatus for the purpose of operating the electro-magnets B C and causing the gas to be let on and shut off at the required times. The parts being in the position seen in Fig. 1 (the gas being shut off) the electric current enters the apparatus at 21 and passes by the wire *s* to a metallic plate, *t*, secured to an insulating block, L, of hard rubber or other suitable material. To the plate *t* is pivoted at 22 a narrow plate, 23, which is also pivoted at its upper end to a bar, 24, of hard rubber, or other suitable material, which is pivoted at 25 to the block L and forms the outer portion of the switch K. The current now passes through the plate 23 to a metallic plate, *u*, secured to the surface of the insulating block L; thence by a wire, *v*, to the electro-magnet C, after passing through which it is conducted by the wire *w* to the framework; and thence, by the gas-pipe or the ground, back to the battery, when the circuit is completed, and the armature *b* is attracted by its magnet, which rocks the shaft D, and, through the connections described, raises the stem *g*, and opens the gas-valve *h* to its full extent. The same movement of the shaft D also rotates the wheel J in the direction of the arrow, Fig. 5, and causes the pin 18 to strike and move the slide *n* which vibrates the switch K into the position seen in Fig. 6. The current cannot now pass from the wire *s* to the plate *u* and wire *v* as the plate 23 is no longer in contact with the plate *u*, and the circuit through the electro-magnet C is thus broken. The current then passes from the plate 23 to a plate, *a'*, on the block L opposite to the plate, *u*, and thence, by wire, *b*, to the next apparatus, where the same operation is repeated, and so on throughout the whole series of lamps; one apparatus only being included within the circuit at a time, the electric current passing from one to another in succession until it has passed through the entire series, the gas-valve *h* of each apparatus being left wide open, as required. As soon as the gas is let on it is ignited by electric sparks in a manner which will be fully described hereafter. When it is desired to shut off the gas another wire, *c'*, is employed;

the current from which passes to a plate, d', thence, by a narrow plate, e', secured to the inside of the bar 24, to a plate, f'; and by the wire $g^{c\prime}$ to the electro-magnet B, after passing through which it is conducted by the wire h' to the frame-work, and thence by the gas-pipe or ground back to the battery, when the circuit is completed and the armature a is attracted by its magnet which rocks the shaft D in the opposite direction to that above described for the purpose of closing the gas-valve h and extinguishing the gas. This movement of the shaft D also rotates the wheel J in a direction contrary to the arrow and causes the pin 19 to strike and move the slide n, which vibrates the switch K back into the position seen in Fig. 1. The current cannot now pass from the wire c' to the wire $g^{c\prime}$, as the plate e' is no longer in contact with the plate f', and the circuit through the electro-magnet B is, consequently, broken. The current then passes from the plate e' to a plate, i', on the block L opposite to the plate f', and thence, by a wire, 26, to the next apparatus, where the same operation is repeated, the current passing successively from one apparatus to another until all of the lamps are extinguished. This last movement of the switch K leaves the plate 23 in contact with the plate u, so that a current can be again sent through the wire s and electro-magnet C to open the valve h, as before described. The plates 23 and e' are arranged on the inside of the bar 24 in the manner seen in Fig. 7, so as to prevent their coming into contact with each other as the switch is moved. It will thus be seen that the breaking of the circuit through the wire s and electro-magnet C will not only cause the current to pass on to the next apparatus, but will leave the electro-magnet B connected with the other wire c', through which a current may be transmitted at the required time, while the breaking of the circuit through the wire c' and electro-magnet B will cause the current to pass on to the next apparatus, and, at the same time, leave the electro-magnet C connected with the wire s; the wires s c' being thus used alternately, one to carry the current for opening the gas-valve, and the other the current for closing it. The electro current which produces the sparks for lighting the gas passes from one pole of the battery by the wire k' to the primary coils M, which produce the sparks, and are placed near the top of the apparatus in close proximity to the burner. After passing through the coils M the current passes by the wire l' to the insulated rod or post N, to the upper end of which are secured two light springs, m' m', which are held in place by a plate, 27, and screw 28, so that they can be adjusted or replaced at small cost when worn out. The other pole of the battery is connected through the frame-work with a sliding rod, O, near the upper end of which is a pin, n' which is raised and lowered in a manner to be presently described; and thus, when the contact between the pin n' and springs m' m' is made and broken, as the rod O is raised the sparks are produced, as required. The gas is admitted to the apparatus at P and passes up through a passage formed in the frame-work A to the pipe Q, to which the burner G is attached. This pipe Q is surrounded near its upper

end with an insulating disk, R. Connected with the pipe Q,
196 below the valve *h*, is an auxiliary burner, S, the small orifice at the top of which is closed by a valve, *p'*, attached to the upper end of the rod O, and this valve is kept closed upon its seat by a spring, *q'*, attached to the rod and the frame-work. T is a pawl or detent, which is pivoted to an arm, 29, secured to the armature *a*. The upper portion of this detent is guided in a slot cut in the frame-work, and when the parts are in the position seen in Fig. 1 its point drops into a notch, 30, in the rod O, in which position it is held by a light spring, 31. As the armature *a* is raised by the descent of the armature *b* the detent T is raised and with it the rod O, which opens the valve *p'* and allows the gas to escape from the auxiliary burner, which is instantly lighted by the sparks produced by the contact between the pin *n'* and springs *m' m'*, being made and broken as the rod O is raised. The orifice through which the gas escapes from the auxiliary burner is on one side only of the valve *p'*, viz., on the side to which the pin *n'* is attached, so that the gas as it escapes will flow directly up to the point where the sparks are produced. At the same time that the auxiliary burner is lighted the valve *h* is opened and the gas issuing from the main burner G is instantly ignited from the flame of the auxiliary burner. A pin, *s'*, at the end of the lever *k* now strikes an incline, 32, on the detent T and throws its point out of the notch 30 in the rod O, thus releasing the latter, when it is drawn down by the spring *q'*, which closes the valve *p'* and extinguishes the auxiliary jet. Instead of the lever *k* with its pin *s'* being used for throwing the detent T out of the notch 30 a stationary incline may be employed, against which a pin on the detent may strike as the latter ascends.

By the employment of two electro-magnets, as above described, but a single motion of the shaft D to which the armatures are secured is required to light or extinguish the gas, which operations can, consequently, be performed in a much shorter space of time than where a ratchet-wheel revolved by a single electro-magnet is employed, while the mechanism does not require to be made with as much accuracy and is, consequently, less expensive and less liable to get out of order.

I do not confine myself to the particular mechanism shown for transmitting the motion of the shaft D to the switch and gas-valve, as it is evident that it may be varied without departing from the spirit of my invention.

The apparatus is surrounded by a conical sheet-metal cover or casing, U, Fig. 8, which serves to exclude dust and moisture.

What I claim as my invention, and desire to secure by letters patent, is—

1. The two electro-magnets B C, operated alternately, in combination with a mechanism connected therewith for operating the gas-valve *h*, and a switch, K, or equivalent device, for breaking the electric current through either one of the electro-magnets and causing the current to pass to the next apparatus, substantially as described.

2. The electro-magnets B C and pawl T with its releasing device

in combination with the rod O, pin n', one or more springs m' m', and the auxiliary burner S, with its valve p', all operating substantially as and for the purpose set forth.

3. The combination of the electro-magnets B C, the rock-shaft D, and connecting-rod e, for operating the gas-valve h, substantially as described.

4. The combination of the lever k with its toothed segment 17, operated by the electro-magnets B C, the pinion l, shaft m, loose wheel p, brake r, friction-clutch q, and the fast wheel J, with its pins for actuating the switch K, all constructed to operate as and for the purpose set forth.

Witness my hand this 26th day of April, A. D. 1871.

JACOB P. TIRRELL.

Witnesses:

P. E. TESCHEMACHER.

W. J. CAMBRIDGE.

200 UNITED STATES PATENT OFFICE.

SAM'L GARDINER, Jr., of New York, N. Y.

Mode of Lighting Gas by Electricity.

Specification forming part of Letters Patent No. 18945, dated December 22, 1857.

To all whom it may concern:

Be it known that I, Samuel Gardiner, Jr., of the city, county, and State of New York, have invented certain new and useful improvements in lighting illuminating-gas by electricity; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, making part of this specification.

The object of this invention is to control and regulate the supply of gas to burners by a mechanism operated by electricity.

The object of my invention is to bring the service or supply cock by which the gas is supplied to a number of burners that are to be lighted by electricity to be opened or closed or made to regulate the supply to the said burners under the control of a person at a distant part of the building or other distant place; and to this end my invention consists in furnishing the service or supply cock with a ratchet-wheel or its equivalent, to be engaged by a pawl or dog or the equivalent thereof attached to one end of a lever whose opposite end has attached to it the armature of an electro-magnet which is made to attract the said armature by an electric current, which may be generated by the same battery or generating apparatus employed for the purpose of generating the current by which the lighting is effected, requiring only a change of circuit effected by a proper arrangement of conductors and a key. By closing and opening the circuit in which the magnet is placed by means of the key the arma-

S. GARDINER, Jr.

Electric Gas-Lighter.

No. 18,945.

No. 232.
Electric G.L. Co.
v.
Barton Electric Co
p. 199.

Patented Dec. 22, 1857.

Fig. 1.

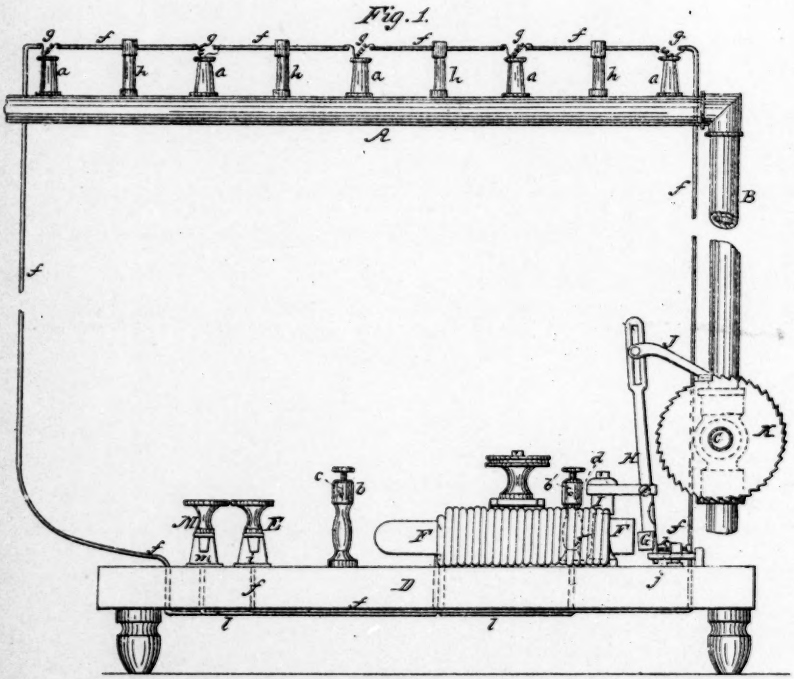
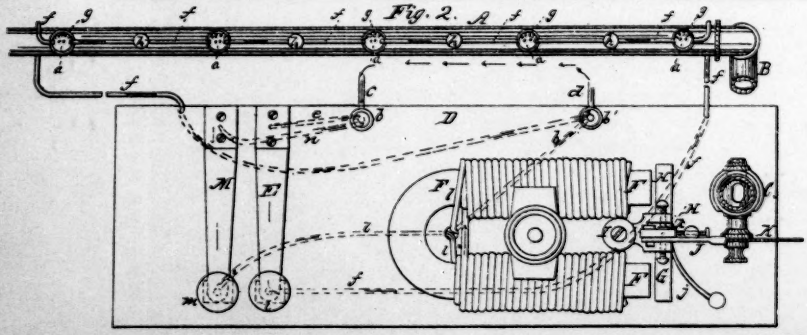


Fig. 2.



ture is alternately attracted toward the magnet by the attraction produced therein by the current and drawn away therefrom by a spring, and by that means motion is given to the pawl to operate the ratchet or other wheel and turn the cock.

The accompanying drawings serve to illustrate the application of the invention.

(Here follows diagram marked p. 199.)

Figure 1 is an elevation, showing a gas-pipe with several burners attached, the service pipe and cock for supplying the same, the lighting-conductors and the wires connecting the same with the battery, and the electro-magnet and branch of the circuit for operating the same to open and close the service-cock. Fig. 2 is a plan of the same.

Similar letters of reference indicate corresponding parts in both figures.

To enable others skilled in the art to make and use my invention, I will proceed to describe the construction and operation of the same.

a a are the burners attached to the pipe A. B is the service-pipe, and C is the cock.

D is a table, to which are attached the wires which constitute the two branches of the circuit for opening the cock and lighting the gas, the two keys for opening and closing the circuit in either branch at pleasure, and the electro-magnet and its armature and lever for operating the cock.

b b' are two screw-clamps secured to the table D, for the purpose of receiving the ends of the two wires *c* and *d*, which constitute the terminal poles of the battery or other generating apparatus. That apparatus is not shown in the drawings, as it may be of any known character, and its nature is supposed to be sufficiently well understood without representation.

From the bottom of the clamp *b* a wire, *e*, runs under the table D to the fixed end of the key E, and from a plate of metal, *i*, attached to the upper surface of the table D, under the knob of the key E, is attached one end of the conducting-wire *f*, in which the platina lighting-conductors *g g* are placed, the other end of the said wire being connected with the clamp *b'*.

The direction of that branch of the circuit between the wires *c* and *d*, of which the wire *f* and lighting-conductors *g g* form parts, is indicated in Fig. 2 by red arrows.

The wire *f*, which should be of copper, leads to all the burners to be lighted by the current; but opposite to each burner it has a short piece cut out or omitted to make room for the fine platina-wire conductor *g*, which is soldered or otherwise attached to it, to stand above and nearly close to the burner for the purpose of lighting the gas. It is preferable, in some respects, to make the lighting conductors *g g* in the form of coils, as shown; but they may be crimped, curled, tangled, or otherwise formed so as to make a small bunch

near the orifices of the burners for the gas to pass through as it issues from the burners.

The conductors should be placed a little on one side of the orifices of the burners, as shown in Fig. 2, in preference to immediately over them, for if placed immediately over them the issuing streams
201 of gas blowing upon them are liable to cool them without being ignited, which is not the case when they are placed so far aside that the gas has an opportunity to expand and become mixed with a certain proportion of atmospheric air before coming in contact with them.

h h are small posts of insulating material attached to the pipe A to support the wire *f*. The branch of the circuit through the wire *f* and conductors is closed by depressing the knob of the key E to bring its point into contact with the plate *i;* but when the pressure of the hand is removed from the key E the said key springs up so as to break the contact between its knob and the plate *i*, and thus open the circuit.

F is the electro-magnet for operating the cock C to turn off and on and regulate the flow of the gas. G is its armature; H, the lever to which the armature is attached; I, a standard supporting the lever H; J, a pawl attached to the lever H, and K a ratchet-wheel on the cock C with which the pawl J engages. *j* is a spring to remove the armature from contact with the poles of the electro-magnet when the branch of the circuit in which the magnet is placed is open. *k* is an adjustable stop-screw to regulate the movement of the armature.

The branch of the circuit in which is the magnet F consists of a wire, *n*, a key, M, a plate *m*, and a wire, *l*, the wire *n* running from the screw-clamp *b* to the fixed end of the key M, and the plate *m* being secured to the surface of the table D below the knob of the key, and having attached to it one end of the wire *l*, which forms the coil of the electro-magnet, the other end of the said wire being connected with the screw-clamp *b'*. This branch of the circuit between the wires *c d* (whose direction is indicated by blue arrows in Fig. 2) is closed by depressing the knob of the key M into contact with the plate *m*, and opened by the elasticity of the key when the knob of the key has the pressure removed from it.

The operation of turning on the gas is effected by playing with the finger on the key M to open and close the branch of the circuit through the magnet F. Every time the circuit is closed the armature is attracted by the magnet, and every time the circuit is opened the armature is drawn away by the spring *j*, thus giving motion to the lever H, and causing the pawl J to operate the ratchet and turn the cock. A very few strokes of the key M will be sufficient to turn on the gas full. When the gas is thus turned on, the branch of the circuit through the magnet is allowed to remain open at the key M, and the other branch through the wire *f* and lighting-conductors *g g* is closed by depressing the key E. The conductors *g g*, owing to the resistance they offer to the passage of the current, both by reason of their being of a size so very much less than the wire *f* and of the inferior conducting-power of the platina, will almost instantly become of a high red or almost a white heat, and will cause the ignition of

the gas. Other metal might be used temporarily in place of platina for the conductors; but there is no other metal of which they could be so easily constructed but that would be soon destroyed by the heat. When the burners are all lighted the key E is allowed to rise, and the circuit through the wire *f* and the conductors *g g* may remain open.

When it is desired to turn off the gas the key M is played upon as in turning it on, to make the magnet operate the pawl to turn the cock.

The wheel K may be marked or graduated in any way to show when the cock is open or closed and how far it is open.

I do not claim to be the discoverer of the fact that illuminating-gas may be ignited by means of electricity; nor do I claim to be the first to suggest the lighting of a street of gas-lamps simultaneously by means of electricity. A method of doing this is described on page 125 of the American Year Book of Facts, 1851, and alleged to be the invention of M. Villatte. In this method a slip of platina is placed close to the orifice of each burner. Nor do I claim the raising and lowering of extinguishers for spirit-lamps by means of electricity, as in the English patent of Mr. Straite, described on page 55, volume 48, of the London Mechanics' Magazine, 1848. In this device the size of the flame is not controlled by the electro-magnet; but in my improvement the supply of gas depends on the movement of the armature, and the latter is perfectly controlled by the finger of the operator. Thus by touching a key the supply-cock may be very gradually turned at the will of the operator, and the supply of gas and consequent size of flame may be regulated with the utmost nicety.

I do not confine myself to the particular method herein described of accomplishing my object; but

I claim, broadly—

Turning on or shutting off inflammable gas by degrees or gradually through the agency of electricity, for such purposes as are hereinbefore alluded to.

SAMUEL GARDINER, JR.

Witnesses:
JAMES F. BUCKLEY.
SELIM FRAS. COHEN.

204 UNITED STATES PATENT OFFICE.

JACOB P. TIRRELL, of Somerville, Massachusetts.

Improvement in Electric Gas-Lighting Apparatus.

Specification forming part of Letters Patent No. 184,807, dated November 28, 1876; application filed January 14, 1876.

To all whom it may concern:

Be it known that I, Jacob P. Tirrell, of Somerville, in the county of Middlesex and State of Massachusetts, have invented certain new

and useful improvements in electric gas-lighting apparatus, of which the following is a specification:

This invention relates more particularly to the electrical gas-lighting apparatus embraced and described in the schedule annexed to the letters patent of the United States issued to me, dated August 20, 1872, numbered 130,770; and it consists in certain improvements in the construction, combination, and arrangement of the parts embraced in said apparatus, all as hereinafter fully described.

In the accompanying plate of drawings,

(Here follows diagram marked p. 203.)

Figures 1 and 2 are views, in elevation, from different sides; Fig. 3, a section in line *x x*, Fig. 1.

In the drawings, A represents a gas-burner, to which B is the feed-pipe, provided with two horizontal platforms, C and D, for carrying the electrical gas-lighting apparatus; E, an electro-magnet, vertically secured to lower platform D, at one side of the gas-pipe; F, the armature to magnet E. This armature is at the upper end of the magnet E, and it is carried by a horizontal lever, H, hung on a fulcrum, at *a*, of the gas-pipe B. I, a post, fixed to upper platform C, and in electrical communication with the earth. This post I has a point, *b*, which is near the burner-slit *c*, and at this point *b*, in the operation of the apparatus, the electrical current is broken by the movement of the circuit-breaker J, which has its point *d* in contact with the point *b* of the post I when it—the circuit-breaker—is at rest. The circuit-breaker is fastened to a vertical rod, K. This breaker-rod K passes loosely through an insulated hole, *f*, of the upper platform C, and also through an insulated hole, *i*, of the armature-lever H and at its lower end it turns on an insulated center, *g*, of the lower platform. H, a wire, connecting breaker-rod K with one pole of the U-magnet E; *k*, a spring-pawl, suspended, at *l*, from the armature-lever H, and engaging with the ratchet-toothed edge *m* of a ratchet-wheel, M, which is fixed to the spindle N of the gas-cock. This pawl *k* is hung so that it can swing sidewise, or across the ratchet-edge of the ratchet-wheel, as the armature-lever moves, and thus adjusts itself to the movement of the lever, which carries it without losing its bearing or hold on the ratchet-teeth. *n o*, two cams, fixed on, and insulated from, the gas-cock spindle, N. These cams are of similar shape, and on each cam bears a separate vertical spring-finger, P P^2, both of which are secured to a common insulated block, O, of the lower platform D. The cam-fingers are each between a common pair of vertical spring-fingers *q* q^2, which are fixed to the insulated block O, above referred to, and one spring-finger, *q*, of the pair *q* q^2, is, by a wire, *r*, connected with the opposite pole of the magnet to that with which the circuit-breaker J is connected, as hereinbefore stated. Fig. 4 is a detail view, showing the spring-finger q^2. The other finger, q^2, of the other pair of spring-fingers *q* q^2, is in two separate parts, both of which are connected by separate wires *s* to the vertical spring cam-fingers of the next burner, and of these wires one, *t*, is the turning-on wire, and the other, U, the shutting-off wire.

J. P. TIRRELL.

ELECTRIC GAS-LIGHTING APPARATUS.

No. 184,807. Patented Nov. 28, 1876.

FIG. 1.

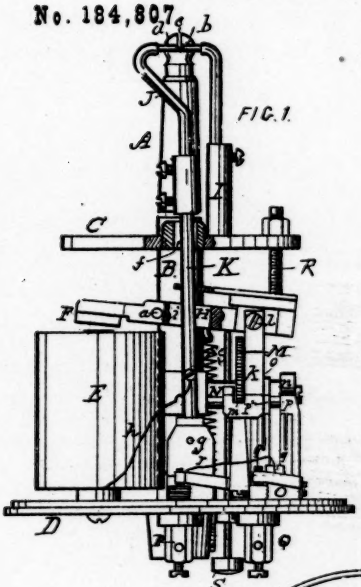


FIG. 2.

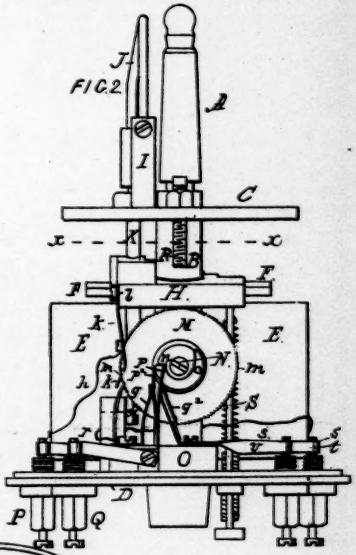


FIG. 3.

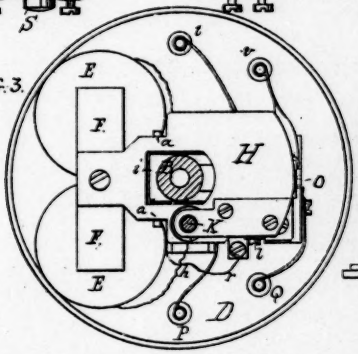
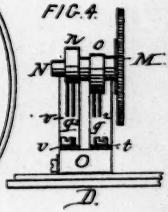


FIG. 4.



No. 232.
Electric L. & C. Co. } p. 203
vs.
Boston Electric Co.

WITNESSES.

Geo. H. Earle

INVENTOR.

J. P. Tirrell
Per Benn Brooks
Attorneys.

P, the turning-on wire, and Q the shutting-off wire, of the burner illustrated. These two wires lead from the electric battery employed, and the wire P connects with one, p^2, and the wire Q with the other, p, of the vertical cam-fingers. The spindle-cams o n are of such shape that, when the finger p^2 of the one cam is against the spring-finger q, the finger p of the other cam, n, will be against the one part, v, of the divided and separated spring-finger q^2, and vice versa, and thus, under the rotation of the cams, the electrical current is thrown into and out of the electrical conducting-wires of the apparatus, substantially as described in the letters patent before referred to, and for the same purposes, and therefore needing no more particular description herein.

The armature F, under the electrical current, alternately moves toward and away from the magnet, and, as the circuit-breaker J passes through it, as described, the circuit-breaker is operated, and made to alternately break and establish the circuit at the burner-slit, a spark being ignited each time the circuit is broken, as aforesaid.

205 The backward and forward movement of the armature operates the ratchet-wheel, and thus is turned on and off, and otherwise than has been herein particularly described this apparatus works and is worked substantially as the apparatus of the said letters patent hereinbefore referred to.

R, a screw, working through upper platform, in a direction for the armature-lever H to abut against it as the armature moves toward the magnet. By adjusting this screw the length of the movement of the armature may be regulated, and thus also the throw of the circuit-breaker. S, a pusher-rod, working through lower platform. This pusher-rod S is for operating the armature-lever H in case the magnet should fail.

Having now described my invention, what I claim, and desire to secure by letters patent, is—

1. The armature-lever H and circuit-breaker K, combined together, and arranged substantially as described.

2. The spring-pawl k, hung on armature-lever H, so that it can swing sidewise, substantially as and for the purpose specified.

3. The push-rod S, arranged to operate armature-lever H, substantially as and for the purpose described.

J. P. TIRRELL.

Witnesses:
CHAS. T. GAY.
EDWIN W. BROWN.

208 UNITED STATES PATENT OFFICE.

JACOB P. TIRRELL, of Somerville, Massachusetts.

Improvement in Electric Gas-Lighting Apparatus.

Specification forming part of Letters Patent No. 206,057, dated July 16, 1878; application filed October 18, 1877.

To all whom it may concern:

Be it known that I, Jacob P. Tirrell, of Somerville, in the county of Middlesex and State of Massachusetts, have invented certain new and useful improvements in electric gas-lighting apparatus, of which the following is a specification:

This invention relates to electrical apparatus for lighting street-lamps in which the current is successively thrown into the magnet at each burner, one after another, and particularly to that class of such apparatus in which the circuit-breaker is located at the burner-tip, and is operated by the armature of the magnet at the burner, which armature also operates a pawl to open and close the valve and secure the automatic switching of the current from its magnet into the magnet of the next burner, and so on through the series of burners which are arranged in the circuit.

The present improvements are particularly in the construction, connection, and arrangement of the several parts, all substantially as hereinafter described, reference being had to the accompanying plate of drawings, in which—

(Here follows diagram marked p. 207.)

Figures 1 and 2 are side elevations; Fig. 3, a horizontal section on line *x x*, Fig. 2; Figs. 4, 5, 6, 7, 8, 9, 10, 11, and 12, views in detail.

In the drawings, A represents a gas-burner, and B its feed-pipe, provided with two horizontal platforms, C and D, which carry the mechanism of this apparatus. E is a U electro-magnet, vertically secured and insulated on the lower platform D at one side of the gas-pipe B. F is the armature to magnet E. This armature is at the upper end of the magnet, and it is secured to the horizontal arm G of an upright lever, H, which turns on a fulcrum, *a*, of the lower platform D.

J is a stud or post on upper platform C, and its screw-threaded part *b* passes through the hole *c* in the platform C; and on the under side of the platform it has a screw-nut, *d*, which fastens it in position.

f is mica lining and washers on stud J, to insulate it and the platform, and also to insulate the two metal arms *g* and *h*, which are fastened to said stud J by said screw *d*, under the platform, from each other, and the one *g* from the stud or post J. *k* and *l* are two wires, one *k*, connecting the arm *h*, and thus the post or stud J, with one

J. P. TIRRELL.

Electric Gas-Lighting Apparatus.

No. 206,057. **Patented July 16, 1878.**

No. 232.
Electric G. L. Co. } p. 207
v.
Boston Elec. Co.

FIG. 1.

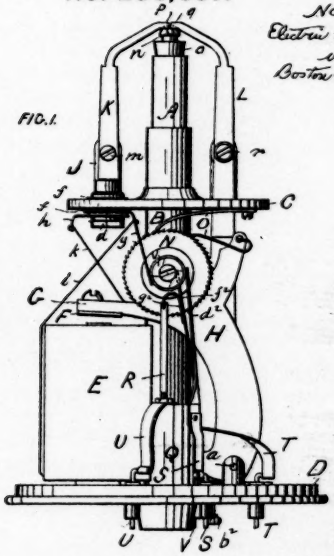


FIG. 2.

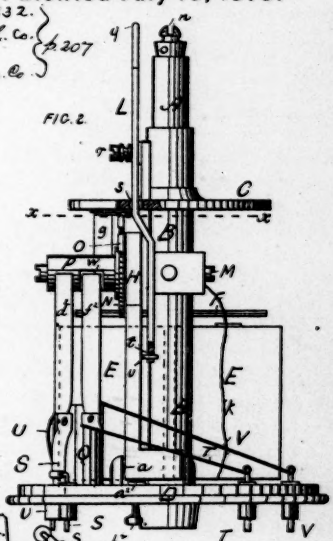


FIG. 10.

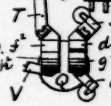


FIG. 3.

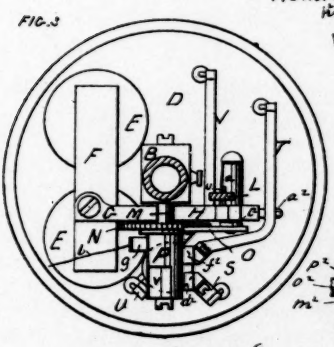


FIG. 11.

FIG. 4.

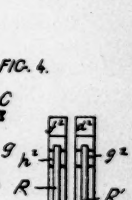


FIG. 12.

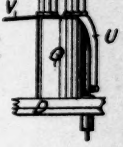


FIG. 9.

FIG. 8.

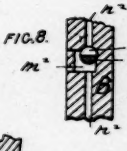


FIG. 6.

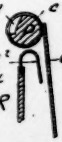
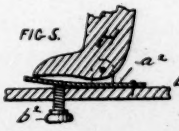


FIG. 7.

FIG. 5.



WITNESSES.

Saml. Dupuy
Geo. H. Earl.

INVENTOR.

J. P. Tirrell.
Per Brown Bros
Attorneys.

pole, and one, *l*, connecting the arm *g* with the other pole, of the magnet.

K is a vertical metal extension of post J, which is fastened thereto by a set-screw, *m*, and ends in close proximity to the slit *n* of the burner-tip *o*, where its point *p* is in contact with the point *q* of an arm, L, which is the circuit-breaker of the apparatus when such circuit-breaker is at rest.

This circuit-breaker turns on a fulcrum, *r*, of the upper platform C, and it extends through an opening, *s*, of the platform down alongside of the vertical lever H, before referred to, and has its forked lower end *t* engaged with a pin, *u*, of such lever.

M is the spindle to the gas-valve, and N a ratchet-wheel fastened to it; and this ratchet, with the valve-spindle, is turned by a spring-pawl, O, secured to the vertical lever H, every time such lever swings forward toward the magnet from the attraction of the armature by the magnet, as will hereinafter appear.

a^2 is a bent spring, arranged to bear on lower end of lever H to throw such lever back and the armature which it carries from contact with the magnet when there is no attraction of the magnet.

b^2 is a screw in lower platform, and in position to bear on the bent spring, so that by screwing it in and out the tension of said spring may be regulated at pleasure, and accordingly the speed of the lever in its forward and backward movements is increased or diminished.

The valve-spindle M projects beyond the ratchet-wheel N, and such projection P is insulated from the ratchet-wheel and its metal connection with the gas-pipe; and it is made of metal c^2, that is cut away in two places, *v w*, and each cut-away place embraces about one-third of the circumference of the projection, and the two places are on opposite sides, but in different vertical planes.

d^2 f^2 are two spring-metal vertical fingers, fastened to an insulated post, Q, of the lower platform D, and in position for the upper free end of the one spring, d^2, to bear upon the valve-spindle extension P in the plane of its one cut-away portion, *v*, and for the upper
209 free end of the other spring f^2, to bear upon the valve-spindle extension P in the plane of its other cut-away portion, *w*.

R R′ are two metal standards, secured to insulated post Q of lower platform D, and terminating at their upper ends with wider plates g^2 h^2, in position for a contact between them and the said spring-fingers d^2 f^2, respectively, when such fingers are off their bearing on the extension P of valve-spindle, and are opposite to the cut-out portions *v w* of such spindle, and to be cut out of contact when such fingers are on their bearing of the valve-spindle extension.

S is the turning-on wire, and T the shutting-off wire. These two wires lead from the electric battery, and the turning-on wire S connects with one spring-finger, d^2, and the shutting-off wire T with the other spring-finger, f^2.

U V are two wires. The one, U, connects the rest-plate g^2 of one spring-finger, d^2, with the same spring-finger of the next burner of the series of burners, and the other, V, similarly connects the rest-plate h^2 for the other spring-finger, f^2, with the same spring-finger of the next burner, and so on through the series of burners.

The metal arm *g*, which, as has been stated, was insulated from the post of the upper platform C and connected with one pole of the magnet by a wire, *l*, is at all times in contact with the extension P of the valve-spindle M, so that when either of the spring-fingers d^2 f^2 is in contact with the said extension P, and the current from the battery is directed into the wire which leads to such spring-finger, the circuit, so long as such contact exists, is then complete through the magnet of the burner where such spring-finger is located to the ground, and passes through said spring-finger to the valve-spindle extension P; thence to the arm *g*, which is always at a bearing on said extension, and from this arm to one pole of the magnet; thence through the magnet to the other pole, and from thence along the wire to the stud, up through the extension K to the circuit-breaker L, and thence through it and the gas-pipe to the ground.

The circuit, when thus complete, through the magnet of a burner attracts the armature F, which swings the lever H, and through this swing of the lever the ratchet-wheel and valve-spindle are turned and the contact of circuit-breaker at the point *p* is broken, whereby a spark is emitted and the circuit through the magnet is broken, destroying its attraction of the armature, which then is carried back to its normal position by the reaction of the bent spring a^2 upon the lever H, which carries it, and thus the circuit-breaker is brought again into contact at the point *p*, which re-establishes the circuit, when the same operation again takes place, and so on until, by the turning of the valve-spindle, its cut-away portion in same vertical plane as the spring-arm through the wire of which the current from the battery is flowing comes opposite to the said finger, which breaks contact with valve-spindle extension and leaves it free to act, comes into contact with its rest-plate g^2 of the standard R′, and thus the current is switched into the next burner of the series, and, operating through the apparatus of that burner, goes from that to the next, and so on, all as above described.

When the one spring-finger is off its bearing on the extension P of the valve-spindle M, the other is on; and thus the apparatus at each burner is at all times in readiness for a current to be directed through its magnet by either the turning-on or the shutting-off wire, as the case may be.

The spring-pawl O is fastened to a stud, l^2, and this stud is fitted in a socket in the lever H, so that by turning it to the left or right the pawl may be made to bear with a greater or lesser force upon the ratchet.

By simply loosening the screw which fastens the extension K to the stud J, the point P of such extension K, which makes the contact with the circuit-breaker L, can be readily adjusted at pleasure.

To detach the circuit-breaker, it is only necessary to first set it off of its fulcrum, when it is free to be lifted through the opening *s* in the platform, as is obvious.

The gas-valve M lies within an enlargement, m^2, of the passage n^2 through gas-pipe to the burner, and it is there placed so that its solid portion o^2 within the said enlargement will close the passage n^2 therefrom to the burner when the valve is properly turned to

bring its solid portion across the same, and that its cut-away portion P^2 will open the said passage to the said enlargement when the valve is properly turned therefor, the enlargement being at all times open to the part of the gas-passage in gas-pipe which is below said enlargement.

This construction and arrangement of the gas-valve secures a letting on in one half-turn of the valve and a shutting off in the other half-turn.

Having thus described my invention, what I claim, and desire to secure by letters patent, is—

1. The combination of the extension P of valve-spindle M, insulated as described, and having cut-away places *v w*, with the spring-fingers d^2 f^2, rest-plates g^2 h^2, and arm *g*, all arranged relatively to each other and connected by wires, substantially as described, for the purpose specified.

2. The insulated stud J, having arms *g h*, which are insulated from each other, and one, *g*, from the stud, and connected the one with one pole and the other with the other pole of an electro-magnet, all substantially as described.

3. The bent spring a^2 and its regulating-screw, in combination with the lever carrying the armature and the circuit-breaker, substantially as described.

4. The combination, with the circuit-breaker L and terminal K, of wires *k l*, connected with opposite poles of an electro-magnet, E, arms *h g*, metallic spindle P, having cut-away portions *v w*, fingers d^2 f^2, connected to wires S T, and the rest-plates R R′, connected with wires V U, substantially as and for the purpose set forth.

5. The combination of pivoted spring-lever H, carrying armature F, and having pin U projecting therefrom, and the pivoted circuit-breaker L, having slot *t* in its end and embracing said pin, substantially as and for the purpose set forth.

6. The combination of pivoted spring-lever H, carrying armature F and spring-pawl O, and having pin U projecting therefrom, the pivoted circuit-breaker L, having a slot embracing said pin, and the ratchet-wheel N, arranged upon the gas-cock spindle, substantially as described.

7. The combination, with lever H, of the circumferentially-adjustable pin l^2, the bent spring-pawl O, rigidly secured to said pin, and the ratchet-wheel N, whereby the pressure of the spring-pawl upon said wheel may be adjusted as desired.

J. P. TIRRELL.

Witnesses:
EDWIN W. BROWN.
GEO. H. EARL.

214 UNITED STATES PATENT OFFICE.

WILLIAM C. CUTLER, of Chelsea, Massachusetts.

Improvements in Electric Gas-Lighting Devices.

Specification forming part of Letters Patent No. 220,704, dated October 21, 1879; application filed July 5, 1878.

To all whom it may concern:

Be it known that I, William C. Cutler, of Chelsea, in the county of Suffolk and State of Massachusetts, have invented new and useful improvements in electric gas-lighting apparatus, of which the following is a specification.

This invention relates to that class or kind of gas-lighters which are arranged to open the gas-cock or liberate the gas by the same movement which produces or generates the igniting-spark; and the invention consists in combining with the gas-burner one or more electro-magnets on each side of such burner, with a rocking bar attached to the gas-cock, by which to rotate the cock to a limited extent, an armature being secured to each end of said bar, and respectively arranged over the poles of the magnets on each side of the burner, so that as the magnets on either side of the burner are rendered operative the corresponding armature will be thus drawn downward, thereby actuating the rocking bar and rotating the gas-cock, thereby, as the respective magnets are made active, alternately opening and closing the cock, the vibrating igniting-point being secured in and actuated by such rocking bar, and a short arm or finger being also secured in the rocking bar, and arranged to make and break ground-contact with an insulated point which is connected with the wires, whereby when the said arm is vibrated in one direction, or when the gas-cock is being closed, no electric spark will be generated, but when operated in conjunction with the movement for opening the gas-cock the ground-contact will be broken in time to generate the electric spark to ignite the gas.

(Here follows diagram marked p. 213.)

Figure 1 is a front elevation of a gas-burner with my invention applied thereto. Fig. 2 is a side elevation thereof as viewed from the right of Fig. 1. Fig. 3 is a top or plan view. Fig. 4 is a horizontal section taken on line C D, Fig. 1, transversely to the burner, and in longitudinal section to the gas-cock and rocking arm.

In these drawings, *a* represents the base or lower end of the burner *c*, which base is formed, in the usual manner, with an interior or female thread for attaching it to the gas-pipe. *b* is a circular flange, which is secured to or formed as a part of the burner. In the upper portion of the burner the usual tip *d* is inserted.

x is a fixed arm, insulated and secured to burner *c*. In this arm is secured the fixed igniting-tip *j*, which is arranged at or near one end of the slit or gas-passage in tip *d*.

W. C. CUTLER. 213

Electric Gas-Lighting Device.

No. 220,704. Patented Oct. 21, 1879.

FIG 1.

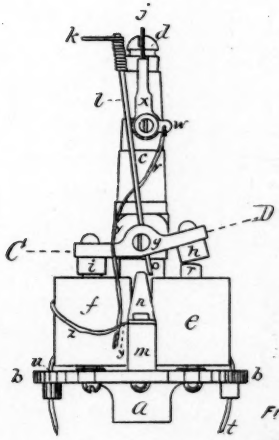


FIG 2.

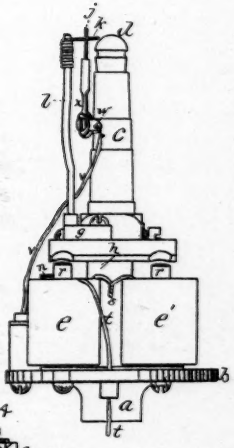
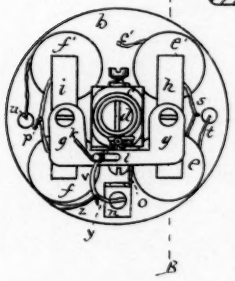


FIG 4

FIG 3



No. 232.
Electric G. L. Co.
vs.
Porter Electric Co
p. 213

WITNESSES
Samuel D. Kelley.
Geo. B. Haskell.

INVENTOR.
William C. Cutler
By Porter & Hutchinson
Attys.

The vibrating point *k* is coiled upon and actuated by the vibrating arm *l*. *e* and *e'* are two coils constituting an electro-magnet secured to base *b* on one side of burner *c*, and *f* and *f'* are similar coils or a magnet secured to this base on the opposite side. The coils *e* and *e'* are united, as shown at *s*, and the conducting-wire *t* thereof passes through insulation in bed *b*, as shown, and is arranged to connect or disconnect with the battery, in the usual manner. The coils *f* and *f'* are united, as shown at *p*, and pass by insulation through the base, as shown at *u*, and are also arranged to connect or disconnect with the battery, in the usual manner.

A wire, *z*, of magnets *f f'* connects with wire *v*, which latter is connected at *w* with the insulated fixed arm *x*, and with wire *y*, which connects with the arm *n*, insulated upon block *m*, as shown.

g is the rocking lever, rigidly secured to gas-cock *b'*, and *h i* are armatures secured to the respective arms of the lever, and respectively over the poles of the magnets, as shown.

The vibrating arm *l* is secured in and actuated by the rocking lever as the same is tilted. A small angle-arm, *o*, is also secured in the under side of the lever, and is, in a reverse direction, actuated thereby; and when the lever is in the position shown in Figs. 1 and 2, the angle-arm *o* is disconnected with arm *n*; but when the position of the lever is reversed, by vibrating it to the right, then arm *o* is in contact with *n*, and thereby, through the agency of wire *y* and the cock *b'*, ground-contact is formed.

In Figs. 1, 2, 3 the positions of the parts are shown as when the gas is turned on and ignited, and the armature *i* drawn down by and upon magnet *f* and *f'*.

When it is desired to extinguish the light, wire *t* is connected with the battery, thereby rendering magnet *e* and *e'* active, when armature *h* will be attracted and drawn down to the magnet, thereby not only vibrating arm *l* to the right of arm *x*, as before described, but also rotating the gas-cock and shutting off the flow of gas. When the gas is thus shut off, point *o* will be in contact with arm *n*, so that when it is desired to ignite the gas a circuit will be maintained by means of the ground-contact thus formed; and as the point *k* will be brought in contact with point *j* before that of *o* and *n* is broken, therefore the circuit will be maintained until the breaking of contact of points *k* and *j*, which breaking will generate the electric spark and ignite the gas, the gas-passage through the cock being opened, by the means described, before such spark is generated.

Ground-contact is maintained with coils *e* and *e'* by wire *c'*, which is permanently connected with base-flange *b*, thereby securing a circuit for the current through these coils when they are rendered active.

I do not claim the combination of the fixed or rigid point *j* and the elastic or yielding point *k*, as the same have been before known and used; nor do I claim any of the constituent parts employed in my invention, but only the specific combinations and arrangements of such parts, as the same are shown in the drawings, described and

pointed out in the specifications, and specified in the following claims:

1. In combination with a gas-burner, *c*, provided with an insulated fixed igniting point, *j*, and a gas-cock, *b'*, a rocking lever, *g*, rigidly secured to and arranged so actuate such cock, and having armatures *h i* secured to its respective ends, and arranged in combination with independent electro-magnets *e f*, which, as they are respectively rendered operative by the electric current, alternately vibrate such lever in opposite directions through their action on the armatures, and thereby turn on or shut off the gas by so actuating the cock, and simultaneously with such movement of the cock vibrate an arm, *l*, carrying a contact-point arranged to generate an electric spark by its contact with the fixed point after the gas shall have been liberated by the described movement of the cock, all substantially as specified.

2. In combination with burner *c*, provided with its tip *d*, insulated fixed point *j*, and rotating cock *b'*, the rocking lever *g*, rigidly secured to such cock, the armatures *h i*, secured to the respective arms of such lever, electro-magnets *e f*, the vibrating lever *l*, with its elastic contact-point *k*, and secured in and actuated by lever *g*, arm *o*, also carried by such lever, and the insulated contact-arm *n* for making and breaking contact, all substantially as specified.

3. In combination with gas-burner *c*, with its igniting-points, and the cock-actuating lever *g*, the vibrating arm *o*, secured to and actuated by such lever, and the insulated arm *n*, all combined and arranged to act automatically, so that as the igniting-points are being brought in contact the arms *n o* will maintain ground-contact until the igniting-points are in contact, but will break such ground-contact before the separation of the igniting-points, all substantially as described and shown.

WILLIAM C. CUTLER.

Witnesses:
DANIEL CURRY.
M. J. FUZZARD.

218 UNITED STATES PATENT OFFICE.

JACOB P. TIRRELL, of Somerville, assignor to George F. Pinkman, of Quincy, Massachusetts.

Electric Gas-Lighting Apparatus.

Specification forming part of Letters Patent No. 230,589, dated July 27, 1880; application filed May 22, 1880. (No model.)

To all whom it may concern:

Be it known that I, Jacob P. Tirrell, a citizen of the United States, residing at Somerville, in the county of Middlesex and State of Massachusetts, have invented certain improvements in electric gas-lighting apparatus, of which the following is a full, clear, and exact

(No Model.)

J. P. TIRRELL. 217

Electric Gas Lighting Apparatus.

No. 230,589. Patented July 27, 1880.

No. 232. Electric G. L. Co. } p. 217.
Boston Elec. Co. }

Fig. 1

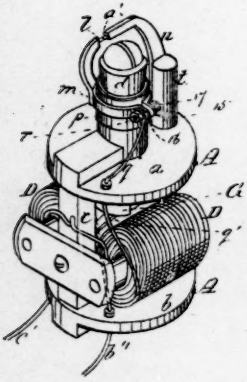


Fig. 8

Fig. 2

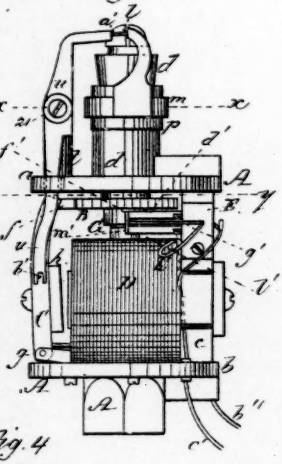


Fig. 3

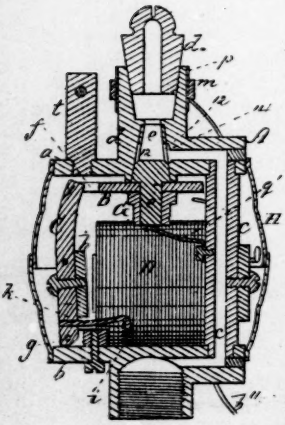


Fig. 4

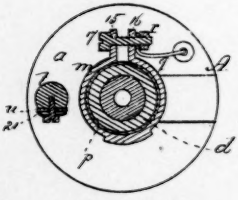


Fig. 6

Fig. 5

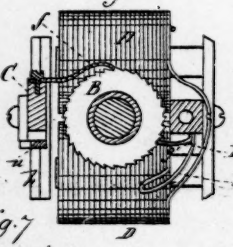


Fig. 9

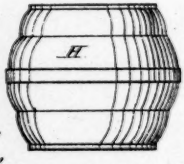


Fig. 7

Witnesses,
W. J. Cambridge
J. C. Godfrey

Inventor,
Jacob P. Tirrell
per R. Stackenmacher
Atty.

description, reference being had to the accompanying drawings, making part of this specification, in which—

(Here follows dragram marked p. 217.)

Figure 1 is a perspective view of my improved electric gas-lighting apparatus, the cover or outer casing being removed. Fig. 2 is an elevation of the same, (enlarged.) Fig. 3 is a vertical section through the center of the same. Fig. 4 is a horizontal section on the line *x x* of Fig. 2. Fig. 5 is a horizontal section on the line *y y* of Fig. 2. Fig. 6 is a perspective view of the cam which operates the circuit-breaker and switch. Fig. 7 is a perspective view of the circuit-breaker and switch and its operating-cam. Fig. 8 is a perspective view of the conical plug of the gas-valve. Fig. 9 is an elevation (on a reduced scale) of the cover or outer casing of the apparatus.

My present invention relates to that class of apparatus in which two separate wires are employed, one for letting on and lighting and the other for shutting off the gas, and has for its object to provide a neat, simple, and compact apparatus, which, on account of the small space which it occupies, is particularly adapted for use in chandeliers and brackets, as it is entirely concealed from view by the ordinary shade or globe placed over the burner.

My invention consists in the employment of a combined circuit-breaker and switch of peculiar construction, operated automatically by a cam connected with the rotary gas-valve, by means of which the electric current is caused to pass alternately by separate wires to the electro-magnet for the purpose of letting on and simultaneously lighting the gas and shutting off the same, the circuit being completed, as usual, by means of keys or pressure-buttons, which are operated alternately to let on and shut off the gas.

To enable others skilled in the art to understand and use my invention, I will proceed to describe the manner in which I have carried it out.

In the said drawings, A represents the frame-work of the apparatus, consisting of two disks, *a b*, united by a tube, *c*, which serves as a conduit for the gas to the burner *d*, projecting from the upper disk, *a*. Within the bottom of the burner is fitted the vertical tapering or conical plug *e* of the gas-valve, which is made hollow and open at its upper end, and is provided with two narrow ports or slots, 12, placed opposite each other, which communicate with the interior of the plug, and are successively brought into line with a port, 14, through which the gas passes from the pipe *c*, so that a quarter-revolution of the plug will cause the gas to be let on or shut off, as required. To the bottom of this vertical plug *e* is secured a ratchet-wheel, B, which is arranged in a horizontal position, as seen in Figs. 2, 3, and 5, and is rotated to actuate the valve-plug *e* by means of a spring pawl, *f*, secured to a lever, C, which is pivoted to the frame-work at *g*, and carries the armature *h* of an electro-magnet, D, which is secured to the tube *c* and arranged between the disks *a b*, a spring, *i*, bearing on a rod, *k*, projecting from the lever, C, serving to withdraw the armature *h* from the magnet when the latter is demagnet-

ized, and thus as the lever C is vibrated in opposite directions by the magnet and spring the gas-valve is rotated to let on or shut off the gas.

l is the stationary or fixed electrode, which is mounted on an arm projecting from a divided metallic collar, *m*, embracing the burner near the tip, the ends of this collar being provided with outwardly-projecting lugs 15, 16, through which passes the horizontal clamping-screw 17, which engages with a screw-thread in the lug 16; and by means of this screw the collar is clamped firmly to the burner to hold the fixed electrode in its proper position, this collar also serving to confine tightly in place a sleeve, *p*, of mica or other suitable insulating material, which is interposed between the collar *m* and the burner to insulate the fixed electrode, which is connected, by means of a wire, *q*, with the electro-magnet. The end of
219 the wire *q* is confined in place by a nut, *r*, turned over the end of the screw 17, the wire being held between the nut and the lug 16, which arrangement facilitates its attachment or detachment. The collar thus serves as a means of attachment for the fixed electrode and also as a clamp for securely holding in place the mica insulating sleeve *p*, this substance being specially adapted for the purpose on account of its capability by resisting the action of the heat to which it is subjected on account of its close proximity to the flame issuing from the tip of the burner.

The construction and arrangement of the collar, with its horizontal clamping-screw *m*, prevent the point of the screw from coming into contact with the mica sleeve *p*, whereas if an ordinary collar were used having the usual set-screw tapped through it the point of the screw would be liable to penetrate the mica and make a contact with the burner, which would destroy the insulation.

To a post, *t*, on one side of the burner is pivoted a lever, *u*, which carries the movable electrode *a'*, this lever, through the frame-work A and the gas-pipe, being connected with the battery.

The lower end of the lever *u* is slotted or bifurcated, and embraces a pin, *b'*, projecting from the lever C, so that when the armature is attracted to the magnet the lever *u* is vibrated, so as to separate the electrodes *l a'*, thus breaking the electric circuit and causing the spring *i* to withdraw the armature from the magnet, when the lever *u* will be moved so as to again bring the electrodes into contact, an automatic circuit-breaker being thus provided, which will keep the lever C constantly vibrating until the circuit is broken through the wire leading to the electro-magnet, as will be hereinafter described; and thus as the lever *u* is vibrated the electrical contact between the electrodes *l a'* is made and broken to produce the sparks to ignite the gas issuing from the orifice at the tip of the burner when the valve *e* is turned by the action of the ratchet-wheel and pawl, as above described.

The distance between the bifurcations at the lower end of the lever *u* is greater than the diameter of the pin *b'* embraced thereby, so as to allow of a lost motion, which enables the armature to have a more extended movement toward and from the magnet, thus increasing the range of the lever C, which increases the size and inten-

city of the electric spark, and also accelerates the rotation of the ratchet-wheel B and valve connected therewith.

The lever *u* is provided at its fulcrum with a spring-washer, 21, which insures the requisite friction at this point to retain the lever in place during the lost motion of the pin *b'* in the slot at the bottom of the lever.

I will now proceed to describe the manner in which the electric current is caused to pass through the apparatus for the purpose of rotating the ratchet-wheel B to open the gas-valve and simultaneously ignite the gas and close the valve to extinguish it at the required times.

b'' *c'* are two separate wires, which can be connected with the same pole of the battery by pressing keys or buttons (not shown), as usual in apparatus of this description, these pressure-buttons being located in any convenient and accessible position within the house or apartment thereof where the burner is located. The gas-valve being closed, the current, on the proper button being pressed, enters the apparatus by the wire *b''*, through which it passes to a light curved spring, *d'*, secured to an insulating block, E. The outer end of the spring *d'* is at this time pressed by one of two projecting portions, *e'*, of a cam, G (composed of hard rubber or other suitable non-conducting material, and secured to the stem of the plug *e* beneath the ratchet-wheel B), against a pin, *f'*, projecting from the upper side of a spring-arm, *g'*, the outer end of which is secured within the block E, and is in contact with a wire, *h'*, connected with the electro-magnet D. The current now passes through the electro-magnet, and by the wire *q* to the electrodes *l a'*, and thence by the frame-work A to the gas-pipe and back to the battery, thus completing the circuit. The ratchet-wheel is now rotated by the vibrations of the lever C, which follow each other in rapid succession, until the plug *e* has been turned a quarter of a revolution, which opens the gas-valve to its full extent, the gas escaping at the tip of the burner having been during the opening of the valve ignited by the sparks produced by the alternate separation and contact of the electrodes *l a'*, as before described. The instant the plug *e* has completed a quarter-revolution the end of the spring *d'* drops into one of the two spaces or notches *i* between the two projections *e'* of the cam, which breaks the contact between the end of the spring *d'* and the pin *f'*, one of two projections, *k'*, on the lower portion of the cam G being simultaneously brought into contact with another curved spring, *l'*, similar to *d'*, and also secured to the insulating-block E, by which means the end of the spring *l'* is pressed into contact with a pin, *m'*, projecting from the lower side of the arm *g'*. The circuit through the wire *b''* is thus automatically broken as soon as the gas-valve is opened to its full extent and the gas lighted, after which the operator removes his finger from the pressure button or key of the wire *b''*.

It will be seen that the armature of the electro-magnet cannot be again set in motion when it is desired to extinguish the gas by a current passing through the wire *b''*, on account of the circuit having been broken, as above described. The other wire, *c'*, is there-

fore employed, through which (on pressing its button) the current passes to the spring l', and thence, by the pin m' and arm g', to the wire h' and electro-magnet, after which it takes the same course as previously described, causing the ratchet-wheel and plug e to be again rotated a quarter of a revolution, and extinguished the gas as required.

On the completion of this movement the end of the spring l' drops into one of the two notches or spaces p' between the two projections k' of the cam G, which breaks the contact between the spring l' and the pin m', thus automatically breaking the electric circuit through the wire c', after which the operator releases the button or key belonging thereto. This latter movement of the cam G again causes one of its projections, e', to press the spring d' into contact with the pin f', when the electro-magnet is again connected with the wire b'', through which the electric current can be again passed when the gas is to be lighted; and it will thus be seen that when, by the rotation of the cam G, the circuit is broken through the wire b'' the switch is operated so as to have the electro-magnet connected with the other wire, c', and when the magnet is disconnected from the wire c' it is at the same instant connected with the wire b'', the wires b'' c' being thus used alternately, as above described, one to carry the current for opening the gas-valve and the other the current for closing it.

The plug e, ratchet-wheel B, and cam G are supported and kept in place by a light spring, q', which is secured to the tube c and bears against the under side of the stem of the plug e, below the cam.

The length of the spaces i p' is the same as that of the projections e' k', the upper projections, e', being in line with the lower spaces, p', and the upper spaces, i', being in line with the lower projections, k', as seen in Fig. 6.

The above-described combined circuit-breaker and switch is simple, and not liable to get out of order, and occupies very little space, while the gas-valve is placed in close proximity with the orifice at the tip of the burner, so that the gas is enabled to issue therefrom almost as soon as the sparks are produced, thereby rendering the ignition of the gas more certain. Furthermore, the arrangement of the horizontal ratchet-wheel, the cam G, and circuit-breaker and switch operated thereby is such as to greatly economize space and enable me to produce an exceedingly neat and compact apparatus, which is provided with a sheet-metal cover or casing, H, Figs. 3 and 9, which serves to exclude dust and moisture.

What I claim as my invention, and desire to secure by letters patent, is—

1. In an electric gas-lighting apparatus, the combination, with the valve-plug e and its actuating mechanism, of the automatic switch and circuit-breaker, consisting, essentially, of the cam G, with its projections e' k' and spaces or notches i' p', the springs d' l', with their connecting-wires b' c', and the arm g', with its pins f' m' and connecting-wire h', whereby the electric current is caused to pass alternately, by the wires b' c', to the electro-magnet D, for the purpose of letting on and simultaneously lighting the gas and afterward extinguishing the same, substantially as set forth.

2. The combination, with the valve-plug *e* and horizontal ratchet-wheel B, of the switch-operating cam G, arranged beneath and in line with the plug *e*, and connected therewith, substantially as and for the purpose set forth.

3. The combination, with the burner *d*, valve-plug *e*, horizontal ratchet-wheel B, operated by the pawl *f*, cam G, and switch operated thereby, and the connecting-wires *b' c' h' q*, of the fixed electrode *l* and the vibrating electrode *a'*, the latter attached to the lever *u*, the lower end of which embraces a pin, *b'*, on the lever C, carrying the armature of the electro-magnet, all constructed and arranged to operate together substantially in the manner and for the purpose set forth.

4. The combination, with the burner *d* and electro-magnet D, of the vertical valve-plug *e*, horizontal ratchet-wheel B, cam G, and the switch operated thereby, arranged between the burner and the electro-magnet to economize space, substantially as described.

Witness my hand this 12th day of May, A. D. 1880.

JACOB P. TIRRELL.

In presence of—
W. J. CAMBRIDGE.
J. O. GODFREY.

224 UNITED STATES PATENT OFFICE.

JACOB P. TIRRELL, of Somerville, assignor to George F. Pinkham, of Quincy, Massachusetts.

Electric Gas-Lighting Apparatus.

Specification forming part of Letters Patent No. 230,590, dated July 27, 1880; application filed May 22, 1880. (No model.)

To all whom it may concern:

Be it known that I, Jacob P. Tirrell, a citizen of the United States, residing in Somerville, county of Middlesex, State of Massachusetts, have invented certain improvements in electric gas-lighting apparatus; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The invention relates to apparatus for lighting gas by electricity in which the gas-cock is opened and closed by electric action upon a mechanical device connecting with such cock and a battery, and in which are employed, in combination with the burner, a stationary metallic arm terminating in a platinum or other metallic point in near proximity to the orifice in the burner, this arm or electrode being fixed to the burner and insulated from it and connected to one pole of a battery, and a movable arm or electrode, which is connected to the other pole of the battery, and pivoted or otherwise connected to the burner in such manner as when vibrated to make and break circuit with the latter and produce a spark to ignite the gas.

In this apparatus I employ two electro-magnets and a vertically-arranged vibrating armature connected with the gas-cock and arranged between the magnets, in combination with a movable and a fixed electrode, the latter being secured rigidly to and insulated from the body of the burner, and is connected with a button wired to an electric battery, while the burner itself is connected with the opposite magnet and a battery by a button, thereby making connection with the movable electrode, the whole being so arranged that the movement of the armature when attracted to one magnet, which is charged from the battery by a pressure upon its button, serves to open the gas-cock, and when attracted to the opposite magnet, by depolarizing the first and charging the second by pressure upon its button, the cock is closed, while as long as the first magnet remains charged by the pressure upon its knob the movable electrode vibrates with rapid intermissions, and certain lighting of the gas is thereby insured.

My present improvements consist in the employment of a horizontal swinging arm attached to the lower end of the vertical gas-cock, this arm being forked and straddling an upright bar erected upon the top of a vibrating armature disposed between two pairs of electro-magnets and caused to vibrate by the closing and opening of an electro-circuit from a suitable battery, the vibration of the armature effecting reciprocation of the lever and cock.

My invention also consists in connecting the armature with the lower end of the movable electrode or arm in such manner that as the armature moves in one direction and opens the cock it causes the movable electrode to separate from the fixed and insulated electrode, thus breaking the electric circuit and producing a spark to light the gas, while a reverse movement of the armature closes the cock and allows the movable arm to return by the stress of a spring and make contact with the fixed arm.

My invention also consists in certain details of construction, as hereinafter more fully described and claimed.

(Here follows diagram marked p. 223.)

The drawings accompanying this specification represent, in figures 1, 2, and 3, front, side, and rear elevations of an apparatus embodying my improvements. Fig. 4 is a longitudinal vertical section through the vibrating armature.

In the said drawings, A represents the gas-burner, and B the cock or gate, which turns on a vertical axis, and is contained within the lower part of the burner, the duct for passage of gas taking a horizontal turn opposite the cock, as shown at C, for a short distance, and then descends vertically, as shown at D, to permit of introduction of the helices below the burner, and finally taking a second horizontal direction, as shown at E below the magnets, or below a shelf, F, which supports such magnets.

The two magnets are shown at H H′ I I′. The fixed in-
225 sulated electrode or arm, which terminates in a platinum point, *a′*, is shown at G as an upright post erected upon a

(No Model.)

J. P. TIRRELL.

Electric Gas-Lighting Apparatus.

No. 230,590. Patented July 27, 1880.

No. 232. Electric G. L. Co. } p. 223
" Boston Elec. Co. }

Fig. 1.

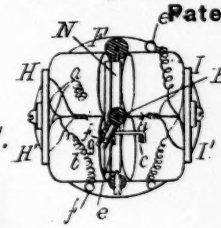


Fig. 3.

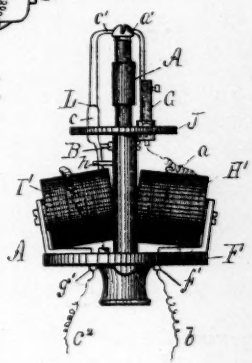


Fig. 5.

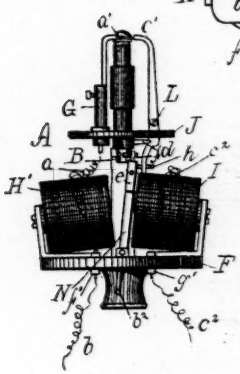


Fig. 2.

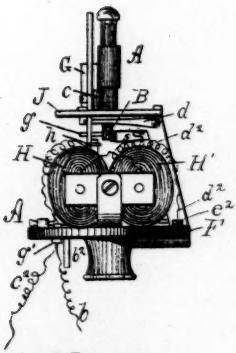
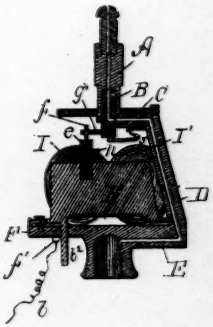


Fig. 4.



Witnesses.

H. C. Dodge.

Inventor.

Jacob P. Tirrell

shelf, J, secured to the portion of the burner containing the cock, one of the wires *a* of one magnet—say H H—being connected with the lower end of such post, while the other wire, *b*, of this magnet H H′ is connected with one pole, *f*, of the battery.

The wire of the opposite magnet I I′, which connects with one pole, *g*′, of the battery, is shown at C^2, while by its other wire, d^2, it connects the other pole of the battery with some suitable part of the gas-burner—say at e^2 in Figs. 2 and 5.

The movable or vibrating arm or electrode is formed at its upper end with a horizontal bend, *c*′, and is shown at L as pivoted to the shelf J, and with its lower and shorter arm, *c*, extending downward through a slot in such shelf, a spring, *d*, being secured at one end to an adjacent part of the burner, and bearing at its free end against the arm *c*, to retract such arm when the attraction of the magnet for it ceases.

N is the armature of the magnets, and is a flat plate disposed vertically between the two pairs of magnets, and pivoted at its lower edge to the shelf F, the upper part of this armature terminating in a post, *e*, the upper extremity, *f*, of which is straddled by the forked end of a horizontal arm or lever, *g*, the base of which is secured to the lower end of the gas-cock. The post *e* further carries a horizontal bent or curved arm, *h*, which clasps about the extreme lower end of the arm *c* of the movable electrode, the length of this arm being such that as the armature stands at one extreme of its movement—that is, away from the magnets I I′—it draws the movable electrode away from contact with the fixed electrode, and breaks contact between the two, and produces the spark, at the same time actuating the forked lever and opening the cock; and when the armature returns to its opposite extreme the cock is closed, and the movable electrode returns to contact with the fixed — by the stress of the spring.

It will be seen that the vibrations of the armature are of such extent and its relations to the gas-cock and movable electrode are such that the cock is opened before the spark is produced. The purpose of this is to cause a sufficient volume of gas to issue from the burner in advance of the spark to insure its ignition by the latter.

In order to sustain the cock B in such a manner that it will be extremely sensitive to the action of the armature, and also capable of adjustment as to tension in turning, I provide a spring, 5, having one end secured to the frame and the free end sustaining the valve B, as shown.

The operation of the apparatus is briefly as follows, supposing the gas-cock of the burner to be in such a position that the gas is shut off and it is desired to let on and ignite the gas, and the two electrodes being in contact: On closing the circuit through the electromagnet H H′ by means of a suitable knob in any part of the circuit, the armature will be attracted in such a direction—that is, toward said magnet—as to vibrate the forked lever and open the cock, and as the armature arrives at the extreme of its movement in this direction its hooked arm engages the lower end

of the movable electrode and actuates the latter in such manner as to cause its upper end to recede from the fixed electrode and break contact with the latter, and by the inductive action of the magnet in the circuit a spark will be produced which ignites the gas issuing from the burner.

In the use of this device the pressure on the knob which charges the magnet H H′ should be continued for a few seconds, as this produces rapid intermittent vibrations of the movable electrode and a corresponding number of sparks, the object of this being to insure the lighting of the gas should the first spark fail to do so. In order that these continued vibrations of the movable electrode and armature may be placed without effect upon the gas-cock, I form the notch in the forked end of the lever of sufficient width to permit of the vibrations of the armature without moving such lever.

When it becomes necessary to shut off and extinguish the gas, by a reverse movement of the cock the knob in the opposite circuit is pressed and the magnet I I′ charged, the effect of which is to attract the armature in the opposite direction and close the cock, while at the same time the movable electrode is returned by its spring to contact with the fixed electrode.

To provide against objectionable results following the failure of the electric current to manipulate the armature and open or close the gas-cock, I add to the lower edge of such armature a horn or arm, b^2, by means of which the armature may be made to open or close the gas-cock independently of the electric current.

I claim—

1. In an electric-lighting gas-burner, a magnet for turning the gas-cock by one electric impulse, combined with a fixed electrode, a', and a movable electrode, c', normally in contact, and mechanism connecting the armature with the movable electrode to break the contact between a' and c' the instant after the gas is turned on, and create a spark for ignition, substantially as described.

2. The magnet H H′ and armature N, provided with pin f, and valve B, provided with the bifurcated arm g, in combination with the movable electrode c' and spring d and yoke or link h, arranged on opposite sides of the lower end of the movable electrode, as set forth.

3. The magnets H H′ I I′, armature N, mounted on a rock-shaft and provided with pin f and yoke h, in combination with the
226 gas-burner A, provided with a vertical valve having a bifurcated arm, g, and spring-support 5, fixed and insulated electrode G, movable electrode c', pivoted at L, and spring d, all constructed, arranged, and operated as and for the purpose described.

4. The armature N, mounted on a rock-shaft and bearing the arm e, and pin f, engaging with a bifurcated arm, g, attached to the gas-cock, in combination with pin b^2, rigidly attached to the armature and extending through the casing, as set forth.

JACOB P. TIRRELL.

Witnesses:
H. E. LODGE.
A. G. MEAD.

(No Model.) 229

T. H. RHODES.

Lighting Gas by Electricity.

No. 242,222. Patented May 31, 1881.

No. 232. Elec. L. & P. Co. } p229
Boston Elec. Co.

Fig. 1.

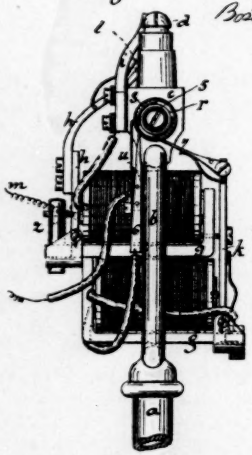


Fig. 2.

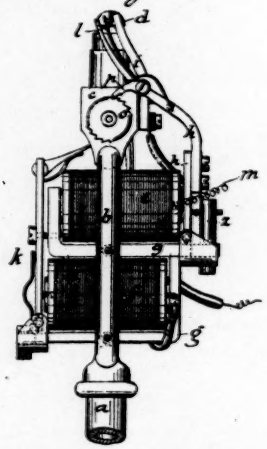


Fig. 4.

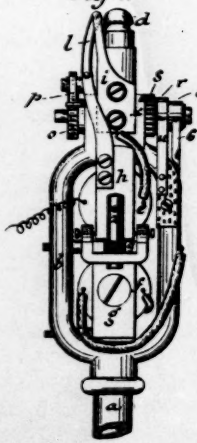
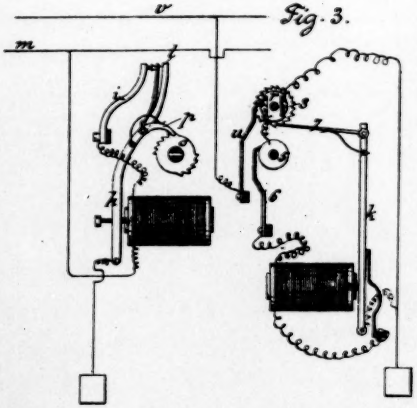


Fig. 3.



Witnesses
Harold Serrell
J. Hailey

Inventor
Thomas H. Rhodes
per Samuel W. Serrell
Atty.

230 UNITED STATES PATENT OFFICE.

THOMAS H. RHODES, of Brooklyn, New York.

Lighting Gas by Electricity.

Specification forming part of Letters Patent No. 242,222, dated May 31, 1881; application filed April 20, 1881. (No model.)

To all whom it may concern:

Be it known that I, Thomas H. Rhodes, of Brooklyn, in the county of Kings and State of New York, have invented an improvement in lighting gas by electricity, of which the following is a specification.

In apparatus for lighting gas by electricity two magnets and two line-wires have been employed, and the cock has been opened and closed by a ratchet-wheel and pawl, acted upon by the magnet-armature.

My invention relates to the combination, with two electro-magnets and the circuit devices, of a cock and ratchet-wheels and circuit-springs, arranged in such a manner that one circuit and magnet turn the cock around until it is open, and the spark is produced at the same time. The ratchet-wheel has blank spaces, so that after the gas is fully on the cock cannot be turned any farther, no matter how many times the spark-producing lever is operated. The second line-wire and magnet are employed for turning off the gas, and in so doing the other ratchet-wheel is brought to the position where the first pawl can act upon it, when the same is moved by the first magnet in turning on the gas and lighting it. When the gas has been turned off, the circuit to the second magnet is broken, so that the further rotation of the cock is arrested.

(Here follows diagram marked p. 229.)

In the drawings, figure 1 is an elevation at one side of the burner. Fig. 2 is an elevation at the other side of the burner. Fig. 3 is a diagram of the circuits, and Fig. 4 is an elevation sidewise of the cock.

The gas-pipe *a* receives upon it the hollow yoke *b*, at the upper part of which is the barrel *c* of a cock and the burner *d*. These are of any usual or convenient construction.

The magnets *e* and *f* are held by the frame *g*, and *h* is the armature to the magnet *e*, and *k* is the armature to the magnet *f*.

An insulated arm, *i*, projecting at the side of the barrel *c* of the cock, carries a platina point or electrode, and upon the armature *h* is a spring-electrode *l*.

When the current is thrown upon the line *m*, it passes through the magnet *e* to the arm *i*, and by the spring-contact *l*, to the armature *h*, and thence to ground through the pivots of the armature *h* and the frame *g* to the gas-pipe. The back-stop *z* of the armature *h*

should be insulated. The parts are adjusted so that just before the entire movement is given to the armature *h* the spring-contact *l* will separate from the arm *i* and draw the spark. This spark being adjacent to the burner where the gas issues ignites the gas. It is preferable to pulsate the current in the line *m*, so that the spark will be sufficiently intense for igniting the gas.

The cock is provided with a wheel, *o*, upon its stem, and this wheel is a sectional ratchet, there being two quarter-sections of teeth and intermediate quarter-sections plain, and upon the armature-lever *h* there is a spring-pawl, *p*, that engages the teeth of *o*; hence the cock will be moved a quarter-revolution by the electric pulsations to open the cock, and it will so remain, as the pawl will then be moved back and forth on the plain portion of the wheel *o*. This gives opportunity for the current on the line *m* to be pulsated a sufficient number of times to insure the opening of all the cocks in the circuit and the ignition of all the gas-jets without turning the cock too far.

When the gas is burning the ratchet-wheel *s* and insulated sectional circuit-closer *r* upon the stem of the cock stand in such position to the wheel *o* that the circuit to the second line-wire *v* is closed by the spring *u*, insulated circuit-closer *r*, and its hub 5, spring 6, magnet *f*, armature *k*, and by its pivots or pawl, or both, to the ground by the gas-pipe *a*.

When a current is charged on the line *v* and pulsated, the magnet *f* acts through the armature *k* and pawl 7 upon the wheel *s*, and moves the same about a quarter-revolution by a step-by-step motion, and extinguishes the light by turning off the gas. When this has been accomplished the circuit-closer *r* has moved until it has separated from contact with the spring *u* and the electric circuit to *f* is broken and the parts cannot be moved any farther, no matter how many pulsations may be continued in the line *v* for turning off the other lamps in the circuit.

The circuit-closer *r* is made in quarter-sections, either with metal and rubber alternated or of metal with quarter-sections removed, so as to break contact with the end of the spring *u*.

When the cock is rotated a quarter-turn to shut off the
231 gas, the wheel *o* is also turned sufficiently to bring its next quarter-section of teeth into the path of the pawl *p*, so that when the current is pulsated on the line *m*, the cock will be again turned to admit gas to the burner-tip, and the spark produced to light the same, as aforesaid.

I claim as my invention—

1. The combination, in a gas-lighting apparatus, of two electro-magnets, two line-wires, an armature-lever operated by one magnet, electrodes that are separated to draw the spark, a pawl, a sectional ratchet-wheel and cock to turn on the gas and close an electric circuit with the second electro-magnet and line-wire, substantially as set forth.

2. In an electric gas-lighting apparatus, the combination, with the cock, of the ratchet-wheel *s*, pawl 7, armature *k*, electro-magnet *f*, circuit-springs *u* and 6, sectional circuit-closer *r*, to turn off the gas,

(No Model.)

J. P. TIRRELL.

AUTOMATIC ELECTRIC GAS LIGHTING APPARATUS.

No. 260,806. Patented July 11, 1882.

Fig. 1.

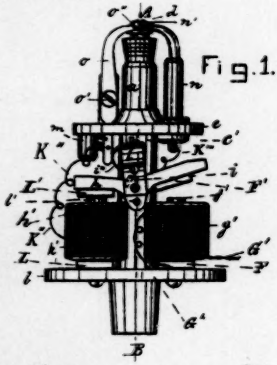
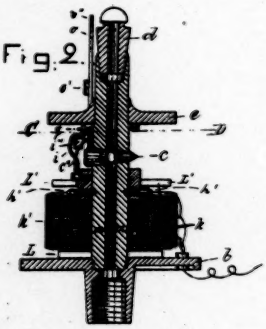


Fig. 2.



No. 232.
Electric G. L. Co.
v. } p. 233
Boston Elec. Co.

Fig. 3.

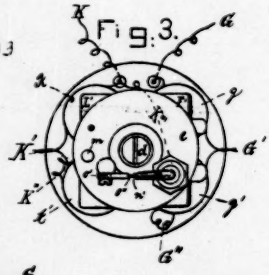


Fig. 4.

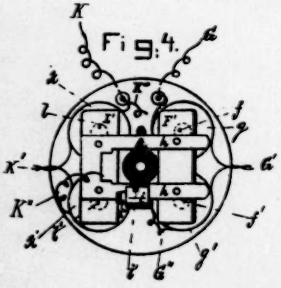
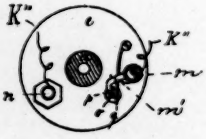


Fig. 5.



Witnesses.
Sarah M. Goodrich
Henry Chadbourn

Inventor
Jacob P. Tirrell
by Albert G. Davis
his atty

and the sectional ratchet *o*, that is brought into position to be acted upon by the pawl *p* in lighting the gas, substantially as set forth.

3. In an electric gas lighting and extinguishing mechanism, the combination, with the gas-burner and cock, of two electro-magnets, two line-wires, armature-levers, electrodes, pawls, ratchet-wheel *s*, sectional ratchet-wheel *o*, sectional circuit-closer *r*, and springs and circuit-closers, substantially as and for the purposes set forth.

Signed by me this 12th day of April, A. D. 1881.

THOS. H. RHODES.

Witnesses:
GEO. T. PINCKNEY.
HAROLD SERRELL.

234 UNITED STATES PATENT OFFICE.

JACOB P. TIRRELL, of Boston, Massachusetts, assignor to the Electric Gas Lighting Company of Portland, Maine.

Automatic Electric Gas-Lighting Apparatus.

Specification forming part of Letters Patent No. 260,806, dated July 11, 1882; application filed December 27, 1881. (No model.)

To all whom it may concern:

Be it known that I, Jacob P. Tirrell, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful improvements in automatic electric gas-lighting apparatus, and I do hereby declare that the same are fully described in the following specification and illustrated in the accompanying drawings:

(Here follows diagram marked p. 233.)

This invention relates to improvements in automatic electric gas-lighting apparatus, and it is carried out as follows, reference being had to the accompanying drawings, on which—

Figure 1 represents a front elevation of the apparatus. Fig. 2 represents a central longitudinal section on the line A B, shown in Fig. 1. Fig. 3 represents a plan view. Fig. 4 represents a horizontal section on the line C D, shown in Fig. 2, as seen from above; and Fig. 5 represents a section on the said line C D, as seen from below.

Similar letters refer to similar parts wherever they occur on the different parts of the drawings.

a is the gas-pipe, having a suitable plate or frame, *b*, attached to it for securing thereto the electrical helices and electro-magnets, hereinafter to be more fully described.

c is the gas-cut-off cock, with its arm or lever *c'* as usual.

d is the trip at the top of the gas pipe or burner *a*, as shown.

Upon the pipe *a*, at a suitable place between the cock *c* and tip *d*, is secured a plate or frame or washer, *e*, which serves as a support for the electrodes, between which the electric spark passes in lighting the gas.

Upon the plate *b* is secured the soft-iron bar F, having upwardly-projecting soft-iron cores *f* and *f'*, surrounded respectively with the electrical coils or helices *g* and *g'* in the ordinary manner of making electro-magnets.

G is the battery-wire connected with the helices *g* and *g'*.

G' is the connecting-wire between said helices, and G'' is the ground-wire from the helix *g'*, which wire may be attached to the gas-pipe *a* or other metallic ground-connection.

At *h'* on the pipe *a* is hinged the rocking armature-lever *h*, to the under side of which are secured the armatures F' and L', one on each side of the fulcrum-pin *h'*, the latter being located below the top of the electro-magnets *f f'*, as shown, to enable me to obtain, in a very small compass, a long lever for the operation of the gas-cock, and also to shorten the distance between the plates *e* and *b*.

Midway on the armature-lever *h* is an arm or lever, *i*, provided in its upper end with a fork or slot, *i'*, embracing the lever *c'* on the gas-cock *c*, by which arrangement said cock *c* is made to close and open by the rocking of the armature-lever *h* on its fulcrum *h'*.

On the plate *b*, opposite the electrical helices *g g'*, are arranged a similar pair of coils or helices, *k* and *k'*, having soft-iron cores *l l'* and connecting bar L, as usual in electro-magnets.

K' is the connecting-wire between the coils *k* and *k'*.

K is the battery-wire to the coil *k*, and K'' is the ground-wire leading from coil *k'* to the bent arm *m'*, having platinum point in its end, and secured to the insulated post *m* on the under side of the plate *e*.

K''' is a branch wire or its equivalent, leading from the wire K or independent battery to the insulated post *n*, secured to the plate *e*, and having platinum electrode *n'* in its upper end, as shown.

On one side of the forked lever *i* is a spring-projection, *i''*, which during the motion of the armature L' toward the electro-magnets *l l'* is brought in contact with the lower end of the rocking lever *o*, which is hinged at *o'*, and provided at top with platinum electrode *o''*, as shown. The lever *o* has a platinum point or projection *p*, which is normally held against the insulated projection *m'* by the influence of a fine spring, *q*, as shown in Fig. 5.

The operation of this my improved gas-lighting apparatus is as follows: In its normal position, when the gas is shut off, the armature F' is resting on the top of cores *f f'*. To light the gas at the tip *d*, the current of electricity from the battery is switched onto the wire K, from which it passes to the coils *k k'*, around the
235 cores *l l'*, causing the armature L' to be attracted to the top of the cores *l l'* and the lever *h* to be turned on its fulcrum *h'* to the position shown in Fig. 1, at the same time causing the gas-cock *c* to be opened by the influence of the forked arm *i i'* on the gas-cock lever *c'*, the wire K'' being for the time the ground-wire from the coil *k*, by the medium of the bent arm *m'*, projection *p*, lever *o*, and gas-pipe *a*, until the projection *i''* comes in contact with the lower end of the lever *o*, causing its platinum breaker *p* to be disengaged from the arm *m'*, (the ground-connection,) and thus cutting out the magnetic cores *l l'* and coils *k k'* from the electrical cir-

cuit, which then passes through the branch wire K''' to the insulated post *n* and its electrode *n'*, where a spark is produced from a spark-coil or its equivalent, in the circuit by the contact of the electrode *o''*, which has been moved up to it by the momentum of the armature-lever *h*, forked lever *i i'*, and spring-projection *i''*, the latter acting on the lower end of the lever *o*. As soon as the spark is produced at the electrodes *o'' n'*, the small spring *q* forces the projection *p* and bent arm *m'* in electrical connection and raises the armature L' away from the top of cores *l l'* by the contact of the lower end of the lever *o* with the side projection *i''*, on the lever *i*, and thus allows the current from wire K to pass again to coils *k k'*, and causes the armature L' to be again attracted to top of cores *l l'*, when the same operation is repeated—namely, contact of spring-projection *i''* with lower end of lever *o*, and forcing its projection *p* away from the bent arm *m'*, and thereby cutting out spools *k k'* from the electric circuit and sending the current again to post *n* and its electrode *n'*, and producing another spark between it and the electrode *o''*, and thus causing intermittent motions of the electrode *o''*, intermittent sparks at the tip for the ignition of the gas, and intermittently cutting out and connecting the spools or coils *k k'* with the electric current from the wire K until the gas is lighted, when the current is switched off by the operator from the wire K, when the various parts remain in their relative positions, as shown in Fig. 1. During the intermittent vibrations of the lever *i*, as above described, it does not vibrate the gas-cock *c*, on account of the forked opening *i'* in said lever *i* being made larger than the width of the cock-lever *c'*. The wire K''' may be made to lead directly and independently from a battery instead of being connected to the wire K, if so desired, to equal advantage. To extinguish the gas it is only necessary to switch the electric current to the wire G and its spools *g g'*, causing the armature F' to be attracted to top of cores *f f'* and the armature-lever *h* to be turned accordingly when the gas is automatically cut off by the influence of the forked lever *i i'* on the gas-cock lever *c'*.

c'' is a small spring secured to the forked lever *i* i^1, and resting on the cock-lever *c'* for the purpose of keeping the gas-cock properly in its shell and to prevent it from getting loose and leaky.

What I wish to secure by letters patent and claim is—

1. In an automatic electric gas-lighting apparatus, the rocking lever *o*, combined with the lever *i*, actuated by electro-magnets and springs *q*, the circuit-breaker *m' p*, and the top breaker *n' o''*, at the burner-tip *d*, to make and break the circuit automatically through a branch or independent wire, as set forth.

2. In an automatic electric gas-lighting apparatus, the combination of lever *i* with rocking lever *o* and breaker parts *m' p* to make and break the circuits of the electro-magnets *k l k' l'*, and breaker parts *n' o''* at the burner-tip *d*, as described.

In testimony whereof I have affixed my signature in presence of two witnesses.

JACOB P. TIRRELL.

Witnesses:
ALBAN ANDRÉN.
LOUIS W. BURNHAM.

238 UNITED STATES PATENT OFFICE.

JAMES H. TOWAN, of Charlestown, Massachusetts, assignor of one-half to Abram Keach, of same place.

Gas-Lighting Apparatus.

Specification forming part of Letters Patent No. 280,689, dated July 3, 1883; application filed February 2, 1883. (No model.)

To all whom it may concern:

Be it known that I, James H. Towan, of Charlestown, county of Suffolk, State of Massachusetts, have invented an improvement in gas-lighting apparatus, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

My invention, relating to an automatic gas lighting and extinguishing apparatus, is embodied in an apparatus of that class in which a valve controlling the flow of gas to the burner is operated by electro-magnets, one for opening and another for closing the said valve, the one for opening it also operating a circuit-breaker in its own circuit to produce sparks for lighting the gas.

This invention has for its object to make the apparatus more reliable in operation and simpler and less expensive in construction than those heretofore in use; and it consists, mainly, in making the armatures of the magnets by which the valves are operated independent of one another.

(Here follows diagram marked p. 237.)

Figure 1 is a side elevation of a burner and its lighting and extinguishing mechanism embodying this invention with the inclosing-case removed; Fig. 2, a front elevation thereof, showing the magnet for opening the valve and operating the circuit-breaker; Fig. 3, a vertical section on line *x x*, Fig. 2; Fig. 4, a vertical section on line *y y*, Fig. 1, and Fig. 5 a horizontal section.

The burner *a*, of any usual construction, is screwed upon the valve-containing or socket piece *b*, which is made of a cylinder of solid metal, threaded at its upper end to receive the burner, and bored and threaded at its lower end, as shown at 2, so as to enable it to be mounted upon a pipe or fixture in the usual manner. The socket-piece *b* is bored longitudinally at its upper end, as shown at 3, nearly through to the socket 2 at the lower end of the piece *b*, to afford a passage for the gas to the burner, and the metal of the piece *b* between the passages or sockets 2 3 is bored transversely to afford a tapering socket for the valve *c*, shown as a tapering plug having a portion of its side removed, as shown at 4, so that it controls by a slight rocking movement the passage or port *d*, which is long in the direction of the valve-socket and very narrow, so that a sufficient area is afforded for the flow of gas, although only a very small rotary movement of the valve is required to open and close the said passage. The smaller end of the valve *c* extends out beyond the side of the

(No Model.)

J. H. TOWAN.

GAS LIGHTING APPARATUS.

No. 280,689. Patented July 3, 1883.

No. 232. Elec. G. L. Co. v. Boston Elec. Co. } p. 237

Fig. 1.

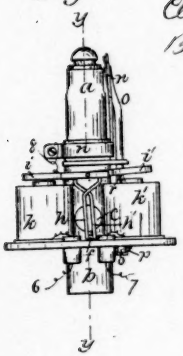


Fig. 2.

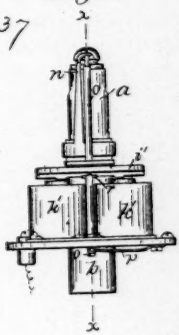


Fig. 3.

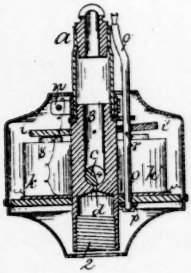


Fig. 4.

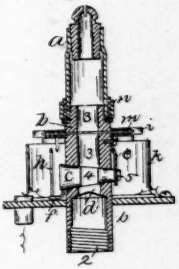
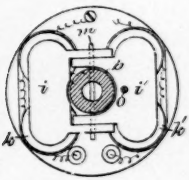


Fig. 5.



Witnesses
A. O. Orne
Fred A. Powell.

Inventor
James H. Towan
by Crosby & Gregory
Attys.

piece *b*, and is provided with an annular groove, 5, which receives a spring, *e*, by which the valve is drawn into its socket, so as to maintain a tight fit therein. The valve is provided with an actuating arm or crank, *f*, engaged and operated by arms *h h'*, connected with the armatures *i i'* of the extinguishing and lighting magnets *k k'*, the said armatures being independent of one another, but mounted upon a common pivot, *m*, as best shown in Fig. 5. One electrode of the extinguishing-magnet *k* is connected with the metal of the burner and gas-pipes, constituting a ground, while the other electrode is connected by wire 6 with a key or circuit-closer for applying a battery when desired to magnetize the magnet *k*, and thus cause it to attract its armature *i*, and thus, by the arm *h* and crank *f*, rotate the valve *c*, so as to interrupt the flow of gas and put out the light. One electrode of the lighting-magnet *k'* is connected by wire 7 with a key for applying a battery, and the other electrode is connected by wire 8 with a fixed contact-piece or electrode, *n*, insulated from the burner and forming one portion of a circuit-breaker, the other movable or vibrating portion or electrode, *o*, of which is electrically connected with the frame-work or gas-fixture and ground, and has a longitudinal movement to and from the piece *n*, it being acted upon by a spring, *p*, which normally keeps it in contact with the piece *n*, thus completing the circuit of the magnet *k'* when the proper key is closed. When the circuit of the magnet *k'* is closed or connected with the battery its armature *i* is attracted, and, by the arm *h'*, acts on the crank *f* of the gas-valve *c*, throwing the said valve, so as to permit the gas to flow, and just before the said armature reaches the poles of its magnets it engages the movable electrode *o* of the
239 circuit-breaker by the projecting pin or shoulder *r*, and, overcoming the spring *p*, moves the said electrode *o* away from the electrode *n*, thus breaking the circuit and producing a spark in the gas issuing from the burner and igniting it in the usual manner. The electrode *o* is automatically vibrated by the armature *i'* and spring *p*, thus producing a series of sparks as long as the battery is connected with the magnet; but the vibration of the armature does not produce any effect on the valve *c* to disturb the flow of the gas, owing to the fact that it is wholly independent of the armature *i* of the extinguishing-magnet *k*, and the arms *h h'* are not positively connected with the crank *f*, but merely press upon its opposite sides, so that each one acts only when its corresponding armature is attracted.

I claim—

The combination, with the burner and gas-valve provided with an actuating-crank, of lighting and extinguishing electro-magnets and their independently-pivoted armatures, each provided with an arm adapted to operate upon the said crank independently of the other, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JAMES H. TOWAN.

Witnesses:

JOS. P. LIVERMORE.

BERNICE J. NOYES.

242 UNITED STATES PATENT OFFICE.

CHARLES H. CROCKETT, of Boston, Massachusetts, assignor to the Boston Electric Company, of same place.

Electric Gas-Lighter.

Specification forming part of Letters Patent No. 281,345, dated July 17, 1883; application filed April 11, 1883. (No model.)

To all whom it may concern:

Be it known that I, Charles H. Crockett, of Boston, Suffolk county, Massachusetts, have invented certain improvements in electric gas-lighters, of which the following is a specification.

My invention relates to automatic electrical gas-lighting burners, and has for its object simplifying the construction so that the parts will operate efficiently and be cheap of production; and it consists in the construction and combination of parts hereinafter particularly described, and then sought to be specifically defined by the claims.

(Here follows diagram marked p. 241.)

In the drawings, figure 1 is a side elevation of the burner with cap removed, and Fig. 2 a cross-section on the line *x x* of Fig. 3; Fig. 3, a part cross-section on the line 1 2, Fig. 1, the cap in place.

In the accompanying drawings, the letter A indicates the base of a cap, B, which envelops the several parts of the device, excepting the burner and the spark-electrodes. A burner, C, passes through the base-plate, and has within it, just above the threads which secure the burner to the gas-pipe, a removable slitted transverse plate, *a*, above which is a conical valve, D, seated transversely in the burner, and held to its seat by the forked end of a spring, *b*, secured to the tube and straddling the circularly-grooved end of the valve, as shown. The removable transverse plate *a* forms part of the seat of the valve, and has a narrow slit for the passage of the gas. The plate may be removed and reground or refitted, when required, to insure a perfect bearing for the valve. The opposite end or base of the conical valve is provided with two pins, *c*, which form shoulders on opposite sides of the valve and project beyond the end thereof. These pins are designed to strike alternately against stop-pins *d*, screwed into base A, so as to check the movement of the valve in turning on and shutting off the flow of gas. The stop-pins are threaded, so as to be adjustable, for the purpose of regulating the throw of the valve. The valve is operated by two armatures, E E′, which are entirely independent of each other, and provided each at one end with a pin, *e*, so that when one armature is tilted its pin will strike one of the pins on the valve, and turn the valve so as to open it, and when the other armature is titled it will strike the other pin on the valve and shut off the flow of gas. These armatures are made independent of each other, so that by no possibility can one discharge the func-

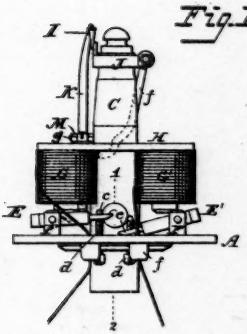
(No Model.) 241

C. H. CROCKETT.

ELECTRIC GAS LIGHTER.

No. 281,345. Patented July 17, 1883.

Fig. 1.



No. 232.
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v.
Bostan Elec. Co
p. 241

Fig. 2.

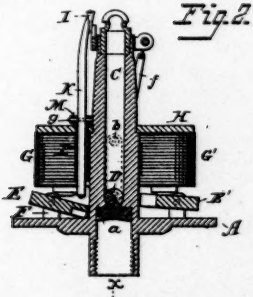
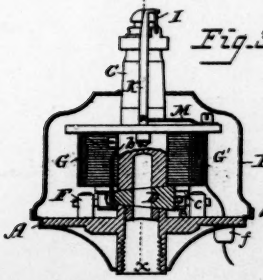


Fig. 3.



Charles H. Crockett

Inventor:
By Charles E. Foster.
atty.

Attest:
Courtland Cooper.
A. E. Hanamann.

tion of the other, for were such the operation the device would not be positive and reliable in its action. The armatures are nearly centrally pivoted to posts F, so that their inner ends will drop, and yet the excess of weight of the heavier ends will require but little, if any, appreciable power to balance the armatures on their pivots. By so pivoting the armatures that their inner ends are lifted by the electro-magnets to a slight extent before contact with the pins *c*, the pins *e* will be given momentum enough to strike the valve-pins a blow, and thereby move the valve with more ease than by steady pressure on the parts. The lower end of the movable electrode is preferably normally out of contact with the armature, so that the armature will attain an amount of momentum before reachiug the electrode, and then give it a sharp blow, causing the electrode to be moved away from the fixed electrode quickly and forcibly, insuring a spark. The armatures are operated by independent electro-magnets G G′, the cores of which are secured to the under side of the soft-iron yoke H, and the ends of the coils of wires are passed through insulators *f*.

A fixed electrode, I, is clamped by a collar, J, to the burner near the top, and the insulated wire of the magnet G is connected with the pin of the collar J, as shown. A vertically movable electrode, K, with a platinum point, slides in a tube, L, pendent from the under face of the soft-iron yoke. The movable electrode is normally kept in contact with the fixed electrode by a flat spring, M, connected at one end to the top face of the iron yoke, and at the other to a pin, *g*, passed transversely through the movable electrode. When the current is on, the magnet G lifts the inner end of armature E and presses it or causes it to strike against the lower end of the movable electrode, projecting the electrode upward from the
243 fixed electrode, and thereby opening the circuit and producing a spark, the breaking of the contact between the electrodes being rapidly repeated as long as the current is in the line, so as to maintain the spark. At the same time that the armature strikes the movable electrode the pin on the armature strikes the pin on the valve, thereby turning the latter, so as to let on the gas. When the flame is to be extinguished, the current is put on the other line, so that the magnet G′ will lift armature E′ and throw its pin against the pin on the value, so as to turn the latter and shut off the flow of gas.

I prefer to have the electro-magnets suspended from the lower face of the iron yoke, but they may be placed on top. In such case the several parts will of course be reversed, and the outer instead of the inner ends of the armatures will be heaviest, and the spring which holds the movable electrode in contact with the fixed electrode may be made to hold up the movable electrode to keep it in contact with the fixed electrode. In that case the movable electrode will of course be moved downward instead of upward to break contact with the other electrode.

The pins on the armatures for moving the regulating-valve, instead of being made separate from the armatures and connected thereto, so as to be adjustable, may be made in one piece therewith.

I reserve for other applications for letters patent any patentable features not specifically claimed.

Having described my invention and set forth its merits, what I claim is—

1. In combination with the rocking valve of a gas-burner, two independently-acting armatures pivoted to strike projections on the end of the valve, one to open the valve and the other to close it, and electro-magnets to actuate the armatures, substantially as and for the purpose set forth.

2. In a gas-burner, the combination of a valve, armatures for moving the valve in opposite directions, electro-magnets for actuating the armatures, and an adjustable stop-pin independent of the armatures for limiting the movement of the valve to less than that of the armature, substantially as and for the purpose set forth.

3. In a gas-burner, the combination of a valve, a stop-pin for limiting the movement of the valve, two independently-acting armatures for moving the valve in opposite directions pivoted so that they can be thrown against the valve, and electro-magnets for actuating the armatures, substantially as and for the purpose set forth.

4. In a gas-burner, the combination of the regulating-valve provided with projecting pins, the independently-acting armatures pivoted, and provided with pins arranged to be thrown against the pins on the valve, the electro-magnets for actuating the armatures, and the stop-pins for limiting the movement of the valve, substantially as and for the purpose set forth.

5. In a gas-burner, the combination of a valve, two independent armatures for moving the valve in opposite directions, electro-magnets for actuating the armatures, a fixed electrode, and a vertically-movable electrode operated by one of the armatures, substantially as and for the purpose set forth.

6. In a gas-burner, the combination with a fixed electrode having a V-shaped depression, a vertically-moving electrode normally resting in the depression of the fixed electrode, an armature for moving the sliding electrode, and an electro-magnet for actuating the armature, substantially as described.

7. In a gas-burner, the combination, with a fixed electrode, of a vertically-moving electrode, an armature for moving said electrode, and an electro-magnet for actuating the armature, the arrangement being such that the armature gains momentum before coming in contact with the movable electrode, as and for the purpose described.

8. In a gas-burner, the combination, with a fixed electrode, of a moving electrode normally in contact with the fixed electrode, a spring for retaining the electrodes in contact, an armature or armature-lever, and a magnet for operating said armature or armature-lever, the arrangement being such that as the armature or armature-lever gains momentum it comes in contact with the movable electrode and forces it away from the fixed electrode, as set forth.

9. In an electric gas-lighter, the combination of two electrodes, one fixed and the other movable, an electro-magnet, and an armature or armature-lever operated by the magnet and supported so as to

gain momentum before striking the movable electrode, substantially as described.

10. The burner provided with the removable slitted transverse plate, in combination with the conical regulating-valve held to its seat by a spring, substantially as and for the purpose set forth.

11. In a gas-burner, the combination of a regulating-valve, two electro-magnets for actuating the armatures, and two independently-acting armatures supported beneath the electro-magnets so as to be raised by the magnets and recede by gravity, substantially as and for the purpose set forth.

12. In an electrical gas-lighting burner, the combination of a valve and an armature for moving the same, supported so as to gain momentum before striking the valve, substantially as and for the purpose set forth.

13. In a gas-burner, the combination of a fixed electrode, a vertically-movable electrode, K, provided with a cross-pin, *g*, a spring, M, connected at one end to yoke H and at the other end to pin *g*, an armature for moving the sliding electrode, and an electro-
244 magnet for actuating the armature, substantially as and for the purpose set forth.

14. In a gas-burner, the combination of a fixed electrode, a vertically-movable electrode, K, provided with a cross-pin, *g*, a tube, L, for the electrode K to slide in, a spring, M, connected at one end to yoke H and at the other end to pin *g*, an armature for moving the sliding electrode, and an electro-magnet for actuating the armature, substantially as and for the purpose set forth.

15. In a gas-burner, the combination of the independently-pivoted armatures E E′, the valve D, the electro-magnets G′ G′, the yoke H, for connecting the electro-magnets, the fixed electrode I, and the vertically-movable electrode K, the several parts being arranged to operate substantially as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CHARLES H. CROCKETT.

Witnesses:

F. BRYANT.
CHARLES E. LOWD.

246 The following is the opinion of the circuit court in accordance with which the decree was entered dismissing the bill of complaint in this cause:

Circuit Court of the United States, District of Massachusetts. In Equity.

ELECTRIC GAS LIGHTING CO.
v.
BOSTON ELECTRIC CO. } No. 2006.

Opinion of the Court (*December* 24, 1886).

COLT *J.*:

This suit is brought on the Tirrell reissue patent, dated June 7, 1881, and numbered 9743. In Electric Gas Lighting Co. *v.* Tillotson, 21 Fed. Rep., 568, and in Electric Gas Lighting Co. *v.* Smith & Rhodes Electric Co., 23 Fed. Rep., 195, Judge Wheeler held the second and fifth claims of the reissue, to be void, on the ground that these claims were broader than those of the original patent. I have carefully considered these opinions and concur in the views therein expressed. The new evidence brought forward by complainant in this case does not tend to overthrow the conclusions of Judge Wheeler, because it is apparent, upon a comparison of the original patent with the reissue, that these claims are void under the authority of Miller *v.* Brass Co., 104 U. S., 350, and subsequent cases.

The only remaining question is whether defendant infringes claim four of the reissue, which is in substance the same as claim
247 two of the original. The claim is as follows: "In an apparatus for lighting gas by electricity, in combination with a circuit-breaker located at the gas-burner, a lever adapted and arranged to open and close the stop cock or valve of the burner, and carrying the circuit-breaker, substantially as herein described." In defendant's apparatus, which is made after the Crockett patent, bearing date July 17, 1883, the two armatures operate to open and close the gas-valve, but there is found no separate lever to open and close the valve and carrying the circuit-breaker such as is described in the Tirrell patent. The defendant's device is so different in construction and mode of operation from that described in the fourth claim that it is clear there is no infringement.

The bill must be dismissed with costs.

Bill dismissed.

248 *Clerk's Certificate.*

UNITED STATES OF AMERICA, } *ss:*
Massachusetts District,

I, John G. Stetson, clerk of the circuit court of the United States for the first circuit and district of Massachusetts, certify that the foregoing is a true copy of the record of said circuit court in the cause entitled Electric Gas Lighting Company, complainants, *v.* Boston Electric Company, defendants, No. 2006, lately determined in said circuit court, and of all proceedings therein and of the opinion of the court therein.

In testimony whereof I hereunto set my hand and affix the seal of said circuit court, at Boston, in said district, this first day of October, in the year of our Lord one thousand eight hundred and eighty-seven, and of the Independence of the United States the one hundred and twelfth.

Seal of the Circuit Court, Massachusetts.

JOHN G. STETSON, *Clerk.*

249 *Bond to Party on Appeal.*

Know all men by these presents that we, The Electric Gas Lighting Company, a corporation existing under the laws of Maine, as principal, are held and firmly bound unto Boston Electric Company, a corporation existing under the laws of Massachusetts, in the full and just sum of five hundred dollars, to be paid to the said Boston Electric Company, its certain attorney, successors, or assigns; to which payment, well and truly to be made, we bind ourselves, our successors, heirs, executors, and administrators, jointly and severally, by these presents.

Sealed with our seals and dated the ninth day of April, in the year of our Lord one thousand eight hundred and eighty-seven.

Whereas lately, at a circuit court of the United States within and for the district of Massachusetts, in a suit in equity depending in said court between said The Electric Gas Lighting Company and said Boston Electric Company, a decree was rendered against the said The Electric Gas Lighting Company, and the said The Electric Gas Lighting Company having obtained an appeal to remove the said cause to the Supreme Court of the United States to reverse the decree in the aforesaid suit, and a citation directed to the said Boston Electric Company, citing and admonishing it to be and appear at a Supreme Court of the United States to be holden at Washington on the second Monday of October next:

Now, the condition of the above obligation is such that if the said The Electric Gas Lighting Company shall prosecute its said appeal to effect and answer all damages and costs if it fail to make its plea good, then the above obligation to be null and void; otherwise to remain in full force and virtue.

THE ELECTRIC GAS LIGHTING CO., [L. S.]
By JOS. S. FAY, *Pres't.*
JOS. S. FAY. [L. S.]
FRANCIS C. FOSTER. [L. S.]

Signed, sealed, and delivered in presence of—
E. P. PAYSON, *To All.*

Approved:
J. E. ABBOTT,
Solicitor for Boston Electric Company.

Approved:
LE BARON B. COLT,
U. S. Circuit Judge.

A true copy of the bond taken by the judge at the time of allowing the appeal named in said bond, which bond is on file in the office of the clerk of the circuit court of the United States for the first circuit and district of Massachusetts.

Attest: JOHN G. STETSON,
Clerk U. S. C. C., Mass. Dist.

250 The United States of America to the Boston Electric Company, a corporation duly organized and existing under the laws of the State of Massachusetts, Greeting:

You are hereby cited and admonished to be and appear at a Supreme Court of the United States, to be holden at Washington on the second Monday of October next, pursuant to an appeal claimed and allowed by the circuit court of the United States for the district of Massachusetts, in a cause in equity wherein The Electric Gas Lighting Company, a corporation duly organized and existing under and by virtue of the laws of the State of Maine, are complainants and appellants and you are defendants, to show cause, if any there be, why the decree rendered against the said complainants should not be reversed and why speedy justice should not be done to the parties in that behalf.

Witness the Honorable Le Baron B. Colt, circuit judge of the United States for the first judicial circuit, this twenty-fourth day of September, in the year of our Lord one thousand eight hundred and eighty-seven.

LE BARON B. COLT,
U. S. Circuit Judge, First Judicial Circuit.

Due, sufficient, and legal service of the foregoing citation is accepted.

JOHN E. ABBOTT,
Att'y for Boston Electric Co., Defendants, Appellees.

Endorsed on cover: Massachusetts C. C. U. S. No. 232. The Electric Gas Lighting Company, appellant, *vs.* The Boston Electric Company. Filed October 14, 1887.

Office Supreme Court U. S.
FILED,
MAR 4 1891
JAMES H. McKENNEY,
CLERK.

SUPREME COURT OF THE UNITED STATES.

No. 282.

THE ELECTRIC GAS LIGHTING COMPANY,
Appellant,

against

BOSTON ELECTRIC COMPANY.

BRIEF FOR APPELLANT.

EDWARD P. PAYSON,
EDWIN H. BROWN,
Counsel for Appellant.

A true copy of the bond taken by the judge at the time of allowing the appeal named in said bond, which bond is on file in the office of the clerk of the circuit court of the United States for the first circuit and district of Massachusetts.

Attest: JOHN G. STETSON,
Clerk U. S. C. C., Mass. Dist.

250 The United States of America to the Boston Electric Company, a corporation duly organized and existing under the laws of the State of Massachusetts, Greeting:

You are hereby cited and admonished to be and appear at a Supreme Court of the United States, to be holden at Washington on the second Monday of October next, pursuant to an appeal claimed and allowed by the circuit court of the United States for the district of Massachusetts, in a cause in equity wherein The Electric Gas Lighting Company, a corporation duly organized and existing under and by virtue of the laws of the State of Maine, are complainants and appellants and you are defendants, to show cause, if any there be, why the decree rendered against the said complainants should not be reversed and why speedy justice should not be done to the parties in that behalf.

Witness the Honorable Le Baron B. Colt, circuit judge of the United States for the first judicial circuit, this twenty-fourth day of September, in the year of our Lord one thousand eight hundred and eighty-seven.

LE BARON B. COLT,
U. S. Circuit Judge, First Judicial Circuit.

Due, sufficient, and legal service of the foregoing citation is accepted.

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Supreme Court of the United States.

The Electric Gas Lighting Company, Appellant, *vs.* Boston Electric Company.	No. 232.

Statement of the Case.

This is a suit for an infringement of a patent relating to automatic electric gas-lighting apparatus. The patent is a reissue. It is numbered 9743, and was granted June 7, 1881, to the assignor of appellant for an improvement invented by one Tirrell. The original patent was numbered 130,770, and issued August 20, 1872.

The apparatus was intended, primarily, for turning on and lighting the gas in street gas-burners from a distant station, and provided with a switching appendage to throw the current into successive burners.

Its use was not, however, limited to lamps in series, nor was the switching mechanism anything but a well-known adjunct.

The patent, so far as it is in issue, covers a new automatic electric gas-lighter. This is a device enabling a distant operator, by touching a push-button or other circuit-closer, to cause the flow of an electric current from a battery to an electromagnet located near a gas-burner. The armature of this magnet operates to turn the gas-cock of the burner, besides moving a circuit breaker which is arranged near the top of the burner and produces a spark from the same current for igniting the gas.

Before this invention no one had produced a practical automatic electric lighter.

Previous apparatus had been impracticable, because requiring an incandescent wire, or a permanently broken circuit at the burner, or if a circuit breaker was there used, at least *two* electric circuits to turn on and ignite the gas. This improvement did away with all these incompetent devices. It underlies all automatic electric gas-lighters which have since been used.

Claims 2, 4 and 5 are in issue. Appellees have relied on :

1st. Invalidity of the re-issue for various reasons.

2d. Non-infringement.

The first has been the main defense, and is the chief question on this appeal. The second defense was specially urged to claim 4.

The opinion of the Court below substantially follows the cases of appellant against Tillotson, 21 Fed. Rep., 569, and against Smith & Rhodes, 23 Fed. Rep., 195; the first of which is pending here on appeal, and is to abide this case; in the second the appeal was not entered because the defendants went out of business.

Questions in the Case.

1. Was not Tirrell's 1872 apparatus a primary invention?

2. Should not claim 1 of the original patent be construed to be for the novel combination of *elements* invented by Tirrell for operating the circuit breaker rather than for merely a method of operating the circuit breaker?

3. Are not claims 2, 4 and 5 of the re-issue lawful re-statements?

4. Was not an armature lever *instantly* opening the gas cock so far an equivalent in 1872 for the armature lever *gradually* opening the gas cock, that a patent including the one as an element of a new combination will equally cover the other?

5. Does the appellee's apparatus, called the " Crockett" burner infringe re-issue claims 2, 4 and 5?

Assignment of Errors.

First.—The Court erred in not construing the original patent No. 130,770, as a patent covering a primary invention, consisting of a single circuit electric gas-lighter.

Second.—In not finding that original claim 1 was intended to cover, and did cover, the same invention as re-issue claim 5, and that original claim 2 was intended to cover, and did cover the same invention as re-issue claims 2 and 4.

Third.—In not finding that original claim 1 was for a novel combination of elements with the circuit breaker, and that it was not only for the circuit breaker operated, but that it included the machinery effecting the operation.

Fourth.—In not finding that original claim 1 was implicitly or expressly for the arrangement of mechanism described, for utilizing a single circuit in turning on the gas and breaking the circuit, and obtaining igniting sparks.

Fifth.—In adjudging re-issue claims 2 and 5 invalid.

Sixth.—In not finding that, in the alleged infringing article, a lever to open the stop cock and carry the circuit breaker and its duplicate to close the stop-cock are within the scope of original claim 2 properly construed, and re-issue claims 2 and 4.

Seventh.—In not finding that appellee's apparatus, the "Crockett" burner, infringed re-issue claims 2, 5 and 4.

Argument.

IN VIEW OF THE STATE OF THE ART BEFORE 1872, TIRRELL'S APPARATUS WAS A PRIMARY INVENTION.

For an appreciation of the complexity of prior apparatus and the distinctive nature of Tirrell's invention, an introductory description of the state of the art is desirable.

In Gardiner's 1857 patent, No. 18,945 (p. 130), electricity being caused to intermittently flow to the magnet *F* by "playing" on key *M*, the armature *G* moves its lever *H*, which, by the pawl *J*, turns the wheel *K*, thereby opening the gas-cock *C*. "The wheel *K* may be marked or graduated in any way to show when the cock is opened or closed, and how far it is open (p. 133)." "The supply of gas depends on the movement of the armature, and the latter *is perfectly controlled by the* finger of the operator." Thus the size of flame may be regulated. Ignition is secured by depressing key *E*, as this will cause electricity to pass by another circuit through fine platinum wire arranged near each burner tip, and render it white-hot. The difficulty of always regulating the igniting current of electricity to the capacity of the wire renders this type of apparatus practically useless, for if the current is insufficiently strong no ignition will be effected and if it be too strong the wire will be destroyed.

Gardiner's improvement involved the "turning on or shutting off inflammable gas *by degrees* or *gradually*," etc. This is called the "step-by-step" movement.

Here then, we have an armature operating a lever upon a ratchet wheel to turn on gas step-by-step, the wheel being marked to show how far to turn it.

In 1866, Gardiner obtained another patent (No. 55,642 p. 97), but one deserving but slight mention here as it merely covered changes of details in mechanism operating a ratchet wheel *H*, whereby the gradual opening of the gas-cocks was effected.

Says Gardiner in his specification (p. 98): "Dark and light colors on the face of the wheel *H* are made to indicate the position of the cock, so that a glance will be sufficient to ascertain whether the gas is fully or partially turned on or off."

Hopkins, in 1859, (patent No. 22,952, p. 99), had a lifting valve, *E*, operated by electrical attraction or repulsion of a magnet *F*. This is of some importance because a single movement of the valve entirely opens or closes it.

In 1865, Frost and Lawrence made a burner which turned on and lighted the gas at once, using an incandescent wire for ignition (Patent No. 49,254, p. 101, and Plaintiff's Exhibit Frost and Lawrence Burner). The current is admitted to the helix *B*, which, thereupon attracts the cylinder *G*, causing lever *E* to turn the valve *D* and let on the gas. The current passes from the helix through wire *O* to small top wire *P*, which, *becoming incandescent*, lights the gas. To turn off the gas the current is admitted to the opposite helix *C* which draws the cylinder *G* back again.

Here we have an armature operating a lever to turn on gas *instantly*, or by a single movement. *It is apparent that such a contrivance was, as early as 1865, the known equivalent of means for operating a gas cock with a step-by-step movement.*

F. Bean's patent taken in 1868, (No. 73,868, p. 103) shows an electro-magnet armature *g* operating a ratchet-wheel *l* opening the valve *r* step-by-step, as in Gardiner's patents. The magnets *c* c^1 are surrounded by *secondary coils d* in which an electric current of great intensity is induced. One secondary coil is connected with the burner tip, *u*, the other with an insulated *stationary* platinum point b^2 *close to* the burner tip. When the magnet is energized, its armature *g* forces the pawl *m* to turn the ratchet *l*, and the latter, through a crank *o* on its shaft, and a spring *p* opens the valve *r*. The current induced in the *secondary* coil causes what are known as jumping igniting sparks to *pass between* the stationary platinum point and burner. These sparks require a current of great energy, hence, the apparatus is practically useless.

E. E. Bean, in his patent of 1869 (No. 90,629, p. 105), condemns earlier apparatus of the type last described, because of

the " very powerful current required." He invented a mechanism whereby, " as soon as the gas-valve has been opened," the current actuating the valve will be switched into a wire leading into the *next* apparatus. The course of the igniting current is sketched in the last paragraphs of page 109, specification. Fig. 5 shows how part 15 of cam *i* pushes lever e^1 away from point 13 of wire e^1 *until space between 12 and 13 is greater than space between 14 and burner tip*, when the current will leap the shorter space.

About 1869 or 1870 apparatus like this was used for street lamps on Park and Beacon streets, Boston, but did not operate successfully. (Pinkham, Int. 6, p. 51. Tirrell, Ints. 3–4, p. 47.)

In 1870 (patent No. 108,434, p. 113) F. Bean thus criticizes earlier apparatus:

> " The methods heretofore employed for igniting gas by electricity have been either to employ an intense or induced current of electricity, which produced a series of sparks by leaping over a break or interruption in the conductor at the tip of the burner, or to pass a current of electricity through a small platinum wire (placed over the tip of the burner) until it became heated sufficiently to ignite the gas. The first of these methods requires the conductor to be heavily coated, in order to secure the necessary insulation to prevent the escape of the electricity, while, when the platinum wire is employed, it is difficult to regulate the force of the current, as an excess of electricity will melt the wire, while an insufficient current will not heat the wire enough to ignite the gas.

There is no testimony in the case to show any greater value in old apparatus than F. Bean here accredits it, nor did he succeed in producing an apparatus of practical value.

He used compressed air to both open the gas valve and operate a circuit breaker. One electrode consists of a small revolving wheel o^1, whose teeth make and break contact with a fixed electrode, *r*, to rupture an electric circuit to produce a spark, as the rod *o* is raised and lowered by the force of compressed air. Teeth formed at the upper end of the rod rotate the wheel o^1.

In 1870 a primary spark lighter, which turned the cock and moved the break piece by electricity was patented by Morris & Reid (No. 101,491, p. 116), although there is no evidence that it was ever used or practically useful. From this

fact, and its great cost, no model of it is at hand, but its essential features will be obtained from the drawings. The patent describes a circuit breaker located at the burner, and operated by an electro magnet. The gas valve is operated *instantly* through a rod actuated by the armature of a second magnet. There is a separate current for each of the magnets. The current which energizes the magnet that operates the circuit breaker flows through the electrodes and makes the spark at their separation. To go more into detail, *one* current energizes magnet B, which attracts armature S, and so *instantly* opens, by lever I, the gas-valve D. The same movement shifts this current away from magnet B into the next lamp by means of a switching mechanism. *Another* current enters magnet C, which draws armature T, moving lever M, releasing small lever P, which, liberating spring M, by which rod O is turned, separates *e* and R, breaking the circuit and lighting the gas by *this* current. The armature opens or closes the valve *instantly* by a rod or lever I, with a fork in its upper extremity, in which rests pin J of valve crank K, which by arbor *a* and lever *b* raises valve D. It should be *specially noted* that wire *g*, magnet B, armature S and lever I open the gas-valve, and that wire *h*, magnet *C*, armature J and lever M operate the circuit breaker, but that *no suggestion* is made of any *combination* of *wire, magnet, armature* and *circuit breaker* by which the *gas can be also turned on.*

Tirrell's *1871* burner, as described in his patent 121,302 (p. 125), and shown by Plaintiff's Exhibit Tirrell '71 Burner, is somewhat like the Morris and Reid, which it will help to explain. It utilizes a primary spark for lighting. It contains two magnets, B, C. *One* magnet, C, actuates an armature, *b*, to open the gas-valve *h*, and bring circuit breaker n^1 on rod O into and out of contact with fixed electrode m^1 m^1. *The other*, B, actuates an armature, *a*, *to close* this valve. It contains another coil, *n*, in circuit with the circuit breaker n^1 of rod O to cause a spark. Tirrell's apparatus as well as Morris & Reid's has two circuits for accomplishing the desired results; but they do not divide the work alike. In addition, they both show a third circuit, magnet and armature *to turn off* the gas.

In the apparatus of Tirrell's said patent 121,302, Fig. 1, the first current enters magnet C, whose armature being attracted works the shaft D, which raises the stem g^c, instantly opening the valve h. The shaft D also (Fig. 3) *raises* armature a, and with it rod O, thus connecting and then separating pin n^1 from fixed electrode springs m^1 m^1. Meanwhile the *second* current passes by wire k to primary coil M, and thence through the circuit breaker to make the spark at the separation of pin n^1 from springs m^1 m^1.

Tirrell's other 1871 patent (p. 120), No. 121,301, has the ratchet or step-by-step motion, to turn the valve. It needs no further comparison with No. 121,302.

Neither of Tirrell's 1871 patents, any more than Morris & Reid's, shows how to make such combination of the letting-on wire, the magnet, armature and circuit breaker, as to permit of operating the gas cock by that armature, and so obtain sparks from the same circuit.

As to the burners of Tirrell's 1871 patents, the testimony shows that "those inventions were never put into practical use;" models were the only specimens (Pinkham, Int. 6, line 14, p. 51, and answer to Ints. 7, 8, 9, pp. 51, 52; Int. 24, p. 49). They were evidently worthless. (See Complts. Exhibit Tirrell 71 Burner.)

This review of the prior patents shows that up to 1872, *no practical automatic electric gas lighter had been made;* nor had the proper *mode of operation* of such machine been thought of.

Field for Invention in 1872.

We have seen that the mode of operation, or the "principle" of all previous gas-lighters, may be said to have been either (1) Turning on the gas and heating a wire, or making a jumping spark to light it. (2) Turning on the gas and moving a circuit breaker and making sparks either by pneumatic power and one electric circuit or by two electric circuits.

All were practically useless, those having the incandescing wire being incapable of use because in practical operation it was impossible to avoid destroying the wire, those depending

on jumping sparks being out of the question because of the expense and danger incident to the heavy current required, and those having provision for primary sparks being too expensive, too complicated and too uncertain by reason of their complications resulting from the employment of two distinct sets of mechanism and two distinct circuits of wiring, or one circuit of wiring and a circuit of pneumatic tubing.

We have further seen that ratchet wheels operating *gradually*, and armature levers acting *instantly* to turn the cock were known equivalents, and that if *switching mechanism*, such as that set forth in the Morris & Reid and Tirrell 1871, patents was not used in connection with a ratchet wheel operating a cock, a ratchet wheel marked to constitute an indicator whereby the position of the cock could at all times be ascertained might be used as a known equivalent so far as the function of the switching mechanism in determining the position of the cock is concerned.

Tirrell's 1872 Invention.

Tirrell's 1872 patent, reissue of which is here in suit, *introduced a wholly new and different mode of opration*. Its fundamental idea was this: Use *one* electric circuit for *three* purposes. Make a machine which shall use neither pneumatic power, nor more than one circuit, but shall yet do three things—turn the gas-valve, move the electrode, and furnish a primary spark. Tirrell emphasizes the difference between prior devices and his 1872 apparatus, saying: (p. 49.)

> "For letting on and lighting gas two electric circuits were used in 1871, in 1872 one electric circuit, and the invention did away with one wire."

The earliest apparatus made according to the new invention was perfectly practical (p. 74, Int. 4, pp. 51–53, Ints. 16, 13, 39 and 18). Some of the early apparatus was used without switching mechanism.

The specification after stating that the invention relates to street lamp apparatus, in which the current is successively thrown into many burners—a *prominent* use of such apparatus

at that date, and one which, as we have seen, had been set forth in prior patents—continues:

"and under this invention the circuit-breaker is located at the burner, and by the direct action of the current through the magnet located at the burner, the *circuit-breaker* and *the valve* to let on or turn off the gas are both operated (p. 93, line 10 from bottom)."

The specification then states how the current may be made to pass on to another burner, and that in the drawings the "invention is *illustrated*." These drawings show a step-by-step-motion to the gas-cock, and the greater part of the specification is consumed in explaining the apparatus as *adapted* to what was its most prominent purpose *i. e.*, gas lamps in series. But later, we find the mode of operation still further explained in such clear fashion as to show that it need not be confined to use in *many* lamps, nor with a gas-cock having a step-by-step motion:

"if, now, a current of electricity be thrown into the wire M, (which, as stated, is the letting on wire), it is obvious it will pass into the magnet * * * * * thence to the circuit-breaker J, and then as the circuit is complete the armature G will be drawn toward the magnet, turning its lever H on its fulcrum, which carries the circuit-breaker J beyond the end of the platinum arm *b*, breaking thereby the circuit and emitting an electric spark. This breaking of the circuit destroys the attractive force of the magnet and leaves the lever H to be pulled backward by the spring L, which backward movement of the lever completes the circuit by bringing the circuit-breaker into contact with the platinum arm *b*, when another attraction of the armature G occurs, again breaking the circuit, emitting a spark, and so on as before." (p. 95, line 32 *seq.*).

The effect of this alternative movement is explained as producing a step-by-step movement of the gas-valve, and then the following summary of results is given (p. 96:

"First, the gas-valve or stop-cock has been opened to its fullest extent, and as at each stroke of the lever H, caused by the successive attraction of the armature, the circuit was broken and a spark emitted, it is obvious the gas necessarily must have been lighted;"

The "second" effect has been to switch the current to a following burner. The "third" effect has been to connect this magnet E and a shutting off wire. (P. 96, line 9, *seq.*)

Of course if no second burner is to be operated, no switch is needed ; and if the magnet be *duplicated*—as in Tirrell 1871 patent 121, 302, the *letting-on* magnet would not need to be connected with a shutting-off wire. That two separate magnets could be substituted for one operated to do two things at different times would be obvious to any one, to say nothing of the fact that they were known equivalents in the art. The specification (p. 96, line 36) continues :

" The location of the circuit-breaker at the gas burner is such, that as it breaks the circuit by escaping from the platinum arm *b*, the spark emitted will be sufficiently near to the escaping gas as to ignite the same, and it is desirable that the movement to let on the gas should be so divided as to admit a sufficient number of sparks to insure the lighting of the gas."

The inventor concludes : " I do not claim turning off or on gas by a step-by-step motion as such is not my invention "—nor could he nor did he claim the switching mechanism resembling, as it did, that described by so many predecessors, but he claimed :

1. A circuit-breaker, located at the burner, and operated automatically, substantially as described."

2. In combination with the above a lever, adapted and arranged to open and close the stopcock or valve of the burner and carrying the circuit-breaker, substantially as herein described."

3. The arms O Q, sector wheels *f n*, pins 1 1^2, *m* m^2, wires M N, magnet E, lever H, carrying armature G, circuit-breaker J, and pawl S, and the ratchet wheel R, all combined and arranged together and applied to a gas-burner for operation substantially as and for the purposes set forth."

Now we have seen a distinctive difference between this invention and everything preceding it. It requires but *one* circuit to furnish a current for accomplishing the turning on of the gas, the vibration of the circuit-breaker and the production of the igniting spark.

The attraction of a magnet moves the armature and its dependencies. These are a circuit-breaker and a gas cock. The first makes and breaks contact with a fixed electrode at the burner tip. A lever opens the gas-valve. When the

magnet pulls its armature the gas-valve moves, the electrodes separate, and a spark from the energizing current appears. Every time this rupture occurs the magnet is de-energized. Instantly the released armature re-establishes the circuit by causing contact of the electrodes. This repeated "make and break" of circuit occasions a series of igniting sparks with the expenditure of very little current.

The invention is thus defined by Prof. Brackett p. 13, Int. 8.

"I find that this patent discloses an invention in which a single current of electricity or a current traversing a single conductor is made to act upon an electro-magnet so arranged as to operate a gas valve or cock to let on the gas and at the same time to rupture a circuit so as to produce a primary spark situated at the tip of the gas-burner in order to ignite the gas so turned on; and in case it is desired to operate so as to operate several lamps in succession switching mechanism is provided whereby the full power of the battery is brought to bear upon each. The same current which actuates the gas-cock is utilized for producing a spark. *I do not find in any prior invention that this has been accomplished.*" (Italics ours.)

Such was the idea—the theory—of the new apparatus. Its inventor was bound to describe only one embodiment of it. Since it involved a new operation it is a primary invention, and under the doctrine of Morley Machine Co. *v.* Lancaster, 129 U. S., p. 273, the patent for it is entitled to a liberal construction.

Now, to particularly examine the original claims:

That claim 1 is blind and misleading, without careful attention, and comparison with the *state of the art* and the *specification*, is freely conceded.

We submit that "operated automatically substantially as described" means operated by the mechanical combination of parts described, and of course the phrase means to refer to the new and distinctive features of the combination. This claim should be construed to include several elements, and not to be for the movable *electrode* only; because, a circuit-breaker at the burner had been previously used, not only by F. Bean and by Morris & Reid, but by *Tirrell himself*, in 1871; and even if characterized by the switching mechanism, would not differ from the Morris & Reid circuit-breaker in that

particular. The language, "*operated automatically substantially as described*," therefore is equivalent to *combined with the wire, magnet and armature, by which the current is utilized as described.*

The specification says the circuit breaker and the gas valve are both to be operated by the "*direct* action of the current through the magnet" (p. 93). The "direct action" of the current does its work by energizing the magnet, so the magnet is clearly an essential element. As this magnet is to let on the gas, the letting-on circuit wire must connect with it. Thus the letting-on wire becomes an essential element. Because the magnet can operate the circuit-breaker and gas-valve only through its armature, the latter becomes essential. The specification further states, that the circuit-breaker is to be in circuit with the coils of the magnet. It is clear, therefore, that the circuit-breaker and the *gas-letting-on* wire are both to be in circuit with the magnet by which the circuit-breaker is operated, which is tantamount to saying that the circuit-breaker is to be operated by and to be in circuit with the gas-letting-on magnet or gas-valve-opening magnet. This is the combination of the first claim properly construed and the invention which Tirrell made.

This view has the unqualified support of Prof. Brackett (pp. 13 and 14, Ints. 8 and 9, and p. 16, Int. 20).

Appellee's experts agree in understanding that the claim is really one for a combination of parts. Each differs from the understanding of Prof. Brackett as to what constitute the elements; but as each differs from the other on this point, the testimony given is not entitled to much weight except where they agree with each other and concur with Prof. Brackett that the claim is for some combination of mechanical elements, and not for a method of operation (p. 36, Int. 7; pp. 68 and 69, Int. 14). Both Prof. Morton and Mr. Freeman show that this claim is entitled to a liberal construction by admitting the non-existence of any single circuit gas lighter prior to this patent (p. 41, Cross Int. 18, and p. 71, Cross-Ints. 19–26).

The second original claim refers to the subject matter of the first.

"2. In combination with the above, a lever, adapted and arranged to open and close the stop-cock or valve of the burner, and carrying the circuit-breaker, substantially as described."

Clearly it is not limited to a particular form of cock or lever.

Prof. Brackett explains this claim in reply to Int. 11, p. 14.

"The device referred to in claim 2 is what has just been set forth in combination with a lever adapted and arranged to open and close the stop-cock or valve and carrying a circuit-breaker. The operation I understand to be as follows: When a current of electricity traverses the circuit, consisting, as I have said, of the wire magnet (by which I mean its helix), and the electrodes constituting the circuit-breaker, the armature is attracted and made to move the gas-cock, which, in the drawings of this invention and in the description, is actuated by pawl and ratchet, and also is made to rupture the circuit at the tip of the burner, thereby producing a spark, and in this case successive sparks, by which the gas is inflamed."

(P. 14.) "Int. 13. Taking the subject matter of claim 1 and the subject matter of claim 2 together, what is the construction and mode of operation of such combination of mechanism?"

Ans. "It would consist of a wire conveying a current joined to one end of the helix of an electro-magnet, whose other extremity is joined to one member of a circuit-breaker, while the other member is so joined as to complete the circuit of the battery, or other source of electricity, when the contact button or switch is properly operated; of an armature actuated by the electro-magnet and adapted to open and close the gas cock or valve and at the same time, by which I mean by one operation of the button, to break the circuit at the burner tip by means of a lever or its equivalent, thereby igniting the gas, which will be by the same operation turned on by means of the gas cock or valve, which is also a part of the same mechanism."

To summarize claims 1 and 2, the first intends a circuit-breaking device, orgarized, as before explained, to utilize the current which opens the valve to also move the circuit breaker and cause the spark; and the second claim mentions expressly a lever and gas cock.

The re-issue is a valid restatement of the original.

Appellant having now presented the state of the art in 1872, and shown the scope of Tirrell's invention then made as defined by the original patent, will now proceed to show the relation of and discuss the re-issue.

The description of the original patent was not changed in the application for the re-issue.

The inventor's re-issue oath states that *he believes* the patent inoperative, explains that he believes it to be so, "by reason of a defective specification," and that he believes the defect to consist in, "the omission of claims for the different combinations" of the elements (p. 83).

Of the eleven re-issue claims (the 5th of which was identical with the 1st of the original patent) as at first made, 1, 2, 3, 4, 5, 10 and 11, were refused by appellee's expert, F. L. Freeman, then examiner, because *old and anticipated* by applicant's own patent of 1871.

Thereupon all but the 5th were erased; a new 1st claim written, the 5th re-numbered 2, and 6, 7, 8 and 9 re-numbered 3, 4, 5 and 6, a new claim written, No. 7, and re-consideration of said 2nd claim requested, "because almost identically the same as claim 1 of the original patent" (pp. 84, 85).

Thereupon claims 1, 3 and 7 were rejected as anticipated by Bean patent No. 90,629 and the further reference, Morris & Reid patent cited against claim 2 (the original patent claim 1), (p. 86).

Thereupon claim 1 was re-written, claim 2 amended by locating the circuit-breaker at "the top" of the burner and re-consideration requested; whereupon Mr. Freeman for the third time, held claim 2 (substantially original claim 1), to be met by Morris & Reid; and it was erased, the numerals changed accordingly, and the re-issue allowed with six claims.

This left the patent with six instead of three claims, and as re-issue claim 3 is substantially original claim 3, (for the specific combination with the switching mechanism), and re-issue claim

4 is substantially original claim 2, we have re-issue claims 1, 2, 5 and 6, some in place of original claim 1 and some for further combinations.

Of these, 1 and 6 are in terms for *combinations* of the single circuit mechanism for operating the circuit-breaker, with mechanism for both turning on *and turning off* the gas. They have not been put in issue in this suit.

The Court in New York, in the Tillotson case (21 F. R., 569) found that the reissue claims 2 and 5, whether or not construed for the circuit-breaking mechanism and *for the gas-cock mechanism as well*, were aptly expressed to cover the original invention, and, also, *defendant's burner;* which, in that case, was substantially like that shown in Tirrell Patent No. 230,590 (p. 14)7.

But the difficulty which the Court had in that case, was in finding that the original first claim covered anything but the "circuit-breaker," meaning thereby a mere movable "electrode." It has already appeared that this was also the opinion of the Patent Office; not, of course when they originally *granted* it, but at the time of the reissue.

Said the Court, in *Smith* and *Rhodes* case, where another form of a single-circuit burner was alleged to infringe this reissue—(23 F. R., 195.)

"The claim in the original was not for any machinery, but the 'circuit-breaker.' It was for the circuit-breaker operated, but that did not include the machinery to operate it. If it included the operation, that is different thing from the means by which the operation is performed.—James *v.* Campbell, 104 U. S., 356, and Powder Co. *v.* Powder Works, 98 U. S., 126. So, whether this 5th claim in the reissue included the machinery for turning on the gas or not, it is for a part of the invention not claimed in the original. Turner & Seymour Co. *v.* Stamping Co., 111 U. S., 319."

In the case at bar, the Court below concurred in this (p. 162).

We submit that the re-issue is perfectly valid as to those claims.

If claim 1 meant, as last construed by the Patent Office, and by the Circuit Courts, only a circuit-breaker at the burner, it covered "more than the patentee had a right to claim as new," and was "invalid."

If claim 1 be invalid then claim 2, depending upon it, falls also; and then the patent entirely ceases to protect the combined means by which for the first time a single circuit is made to operate the gas-cock, and the circuit-breaker, and also furnish the igniting spark, as so clearly explained in the description.

Original claim 3 would be insufficient for the purpose, being expressly for a combination including a switching mechanism.

Claim 1, whether or not invalid, as aforesaid, was certainly obscure, unintelligible and defective, as shown by its capability of diverse constructions notable in the testimony of the experts in this case, and in the action of the Patent Office where it was first upheld and afterwards refused.

When the original patent was granted originally the Patent Office must either have been ignorant of the state of the art, or else meant, in the then more lenient practice, to include in the words "operated automatically substantially as described" the *means* therefor; while at the time of re-issue, the same office *refused* to allow it, this excluding the latter construction.

There is then, either of two statutory grounds for the re-issue: (1) invalidity of a claim for what the inventor had "no right to claim as new;" and (2) inoperativeness arising from "a defective or insufficient specification;" if occurring, in either case, by "inadvertance, accident or mistake, and without any fraudulent or deceptive intention."

The whole record negatives such intention, and affirmatively shows the inadvertance, accident and mistake, which consisted in trusting to the words "operated automatically substantially as described" in claim 1, by which both the inventor in asking, and the Patent Office in then granting, clearly meant to include the *described means*.

Of course Tirrell, familiar with the Bean circuit-breaker, and himself the patentee of apparatus containing such a device, only a year earlier, can not be supposed to have *intended* to dedicate his new mode of operation, and the means embodying it, and to vainly ask for an *old* circuit-breaker; and there is no

presumption of ignorance of the state of the art by the Patent Office.

If the claim is not construable in accordance with our contention, both the Patent Office and the patentee made a "mistake." It matters not whether the mistake was from want of knowledge of the state of the art, or as to the construction which would be put by the courts upon the words "operated automatically substantially as described."

If we are right so far, we have shown a proper case for *a* re-issue, upon either of two grounds, and have only to consider whether re-issue claims 2 and 5 properly express what the re-issue could be granted for.

Clearly claim 5 of the re-issue corresponds to the 1st claim of the original patent when the latter is construed as above set forth. The said 5th claim is as follows:

"5. In an apparatus for lighting gas by electricity, the combination of a wire through which a current of electricity is passed, actuating mechanism for letting on the gas, an electro-magnet electrically connected with said wire, an armature operated by said electro-magnet, mechanism actuated by said armature, breaking the circuit at the burner tip, and producing there an electric spark or sparks for lighting the gas, the whole operating automatically."

The question as to the validity of this claim may be subdivided into

(a) Is it for what the inventor intended, but inadequately expressed by claim 1 ?

(b) Does the clarifying of original claim 1 constitute an expansion when worded as in reissue claim 5 ?

(a) Concede that, taken literally, and excluding the specification, claim 1 calls only for a circuit breaker—two bits of metal which were old, yet, as with the *explanation* of the specification, and the differentiation from the prior art, the claim appears to be for a *new* thing, should it not be taken as thus elucidated rather than literally ?

(b) If claim 5 be for exactly what original claim 1 covers when

so elucidated then it is not for anything *more* than, and cannot be an expansion of claim 1, but must be held to be a mere restatement.

Moreover "operated automatically, substantially as described," cannot be rejected as surplusage; but if not, these words import *the means* described in the specification.

Union M. C. Co. *v.* U. S. C. Co., 112 U. S., 624.
Howe Mch. Co. *v.* National Needle Co., 134 U. S., 388.

A claim for an operation by elements described in the specification can be construed only by referring to the specification, and by including the necessary elements.

Seymour *v.* Osborne, 11 Wall., 516.
Fuller *v.* Yertzer, 94 U. S., 288.

"Claiming the arrangement of a combination, when the arrangement is such as to produce a given mechanical result of the combination, is *not a claim to a function.* The result is not claimed, irrespective of the means producing it."—Mr. Justice Blatchford in Renwick *v.* Pond, 10 Blatch., 37, and Hitchcock *v.* Tremaine, 8 Blatch, 440; and see his observations in Wooster *v.* Blake, 8 F. R., 429.

In Powder Co. *v.* Powder Works, *ante*, the Court refers to the assistance to be derived from testimony as to *identity or non-identity* of inventions in original and re-issued patents when the question is a complicated one. Therefore in this case the appellant offers testimony of a distinguished authority upon electrical action, to show that *the embodiment of original claim 1, is also the embodiment of re-issue claim 5.* Being asked to compare original claim 1, with re-issue claim 5, he says, (p. 16, Int. 20):

"We have, therefore, a wire conveying a current of electricity, an electro-magnet electrically connected with the wire, an armature, a circuit-breaker connected and arranged so as to let on the gas and ignite it by a spark. I find, therefore, the four things enumerated which were enumerated under claim 1 of the original and operating in the same manner as has been previously pointed out in considering that claim. *The claims are, therefore, in my opinion, substantially identical.*"

Complainant further contends that claim 4, re-issue, is substantially but a repetition of claim 2, original. These claims are as follows:

Original Patent 2. "In combination with the above (*i. e. claim* 1) a lever, adapted and arranged to open and close the stop-cock or valve of the burner and carrying the circuit-breaker, substantially as herein described."

Re-issue 4. "In an apparatus for lighting gas by electricity, in combination with a circuit-breaker located at the gas burner, a lever adapted and arranged to open and close the stop-cock or valve of the burner, and carrying the circuit-breaker, substantially as herein described."

As original claim 2 was for an apparatus, novel in construction and operation, revealed by the specification, omitting the switching mechanism, so is re-issue claim 4; including, therefore, the wire, magnet, armature, lever (continuous, or otherwise, with the armature), circuit breaker and gas-cock or valve, combined so as to be operated by a single circuit.

As Professor Brackett puts it:

"There is, therefore, involved the same elements as set forth in claim 1 in combination with claim 2 of the original, to wit, a wire conveying a current, an electro-magnet operating an armature, a stop-cock to be operated by said armature, a circuit-breaker likewise operated by the agency of a lever actuated by said armature; the whole arranged and operating as previously set forth, as when considering those claims, namely to turn on the gas and ignite it at the burner tip." (Record, p. 16, Int. 21.)

Re-issue Claim 2 is as follows:

2. In an apparatus for lighting gas by electricity, the helix of an electro magnet connected at one end with the wire through which the current of electricity is passed, and at the other end with a circuit-breaker located at the gas burner, so arranged that the current of electricity is passed to the circuit breaker through said magnet, attracting an armature-actuating mechanism operating automatically to turn on the gas and light the same by the effects of the primary sparks made at the tip of the burner from said magnet in the circuit.

As complainant contends, it is also based upon original 1st and 2nd claims.

The original 1st claim, as above construed *implicitly* covers

and reissue claim 5 *expressly* covers, the combination of wire, magnet, armature by which the cock is opened, and circuit-breaker operated by and in circuit with such magnet; to which elements re-issue claim 2 adds mechanism for letting on the gas, to be actuated by said armature.

This re-statement by re-issue claim 2 is allowable, for the single circuit was, by the fundamental idea of the structure, *intended* to let on the gas, and so implied mechanism therefor. Mechanism having such function was, also, expressly named in original claim 2 and shown in the drawings.

As to these claims appellant confidently and earnestly contends:

First.—That under doctrines of this Court lately reiterated in Morley *v.* Machine Co., 129 U. S., 263, and there illustrated by many cases, including Proctor *v.* Bennis L. R., 36 Ch. Div., 740, Mr. Tirrell's 1872 invention should not be limited to an improvement upon a known machine; not only because *no* practicably useful automatic electric gas-lighter then existed upon which to make such improvement, but also because, could any of these earlier attempts be pronounced such a gas-lighter no one of them is pretended to have furnished the *igniting sparks* from the same electric circuit which furnished *the power* to move both the cock and the circuit-breaker. This was first done by Tirrell's apparatus in which the circuit-breaker was put in circuit with the magnet and its armature made to communicate motion to the circuit-breaker and to the gas-cock.

This invention only is the subject-matter of these re-issue claims, as it was the *intended* subject-matter of original claims 1 and 2.

Second.—The failure to rightly phrase the original claims arose from such inadvertence, accident and mistake as this Court has considered a condition precedent to the right to a re-issue with enlarged claims after considerable delay; for the record as a whole shows "a real, *bona fide* mistake inadvertently committed, such as a Court of Chancery, in cases within its ordinary jurisdiction, would correct."

Miller *v.* Brass Co., 104 U. S., p. 355.

Inspection of the original claims so blindly drawn, so susceptible to contrary constructions, could not reveal that the means of operating the circuit-breaker were no part of claim (1), or that it covered *only* a circuit-breaker, or that a circuit-breaker was old, or that patentee had claimed thereby more than he had a right to claim as new, or that the Patent Office would refuse the same claim thereafterwards, thus becoming a party to a mistake in granting or refusing to grant it, or that (by the vagueness or invalidity of claim 1) claim 2 was meaningless or inadequate.

According to the later view of the Patent Office, shared since by the Courts below, the true subject-matter requiring protection was not properly shown in the original claims. This was a mistake in description, a mistake of *fact* proper to be relieved against accordingly.

Spence Eq. Jur. of Ch., Vol. 1, 621, *seq.*
Snell *v.* Ins. Co., 98 U. S., 85.

Third.—But as there has been no enlargement of the claims as intended to be made, the case at bar is more clearly one of "correction of a patent by means of a re-issue where it is invalid or inoperative for want of a full and clear description of the invention," and "where the original claim is too broad."

Miller *v.* Brass Co., ante.
Mahn *v.* Harwood, 112 U. S., 384.
Union Cartridge Co. *v.* U. S. Cartridge Co., 112 U. S., 384.
Eames *v.* Andrews, 122 U. S., 40.

Infringement.

If the Court accepts complainant's positions thus far, the question of infringement will not present much difficulty.

Tirrell's 1880 patent, No. 230,590 (p. 147), covering defendant's Exhibit No. 3 and Crockett's 1883 patent No. 281,345 (p. 158) show apparatus substantially like complainant's Exhibit defendant's Burner, which is the alleged infringement.

We contend that re-issue claims 2, 4 and 5 have been infringed.

The circuit-breaker operated by the armature of the magnet which turns on the gas, which magnet is in circuit with the circuit-breaker, is evidently taken, and claim 5 clearly infringed.

The *form* of the gas-cock mechanism in the re-issue patent is such that the gas is turned on "step-by-step" (as in the 1857 Gardiner patent, p. 131), and not "instantly" (as in 1865 Frost & Lawrence patent, p. 101).

The language of the re-issue claims 2 and 4 does not confine the gas-cock to a "step-by-step" movement. Neither did original claims 1 and 2; and there are two grounds for *not* confining Tirrell to a "step-by-step" movement. 1st, the patent being a pioneer *nobody* could use that, or any other, gas-cock movement, with Tirrell's *circuit-breaker and described means of operating it*, including the armature which actuates the gas-cock; 2nd, at least, nobody could use *Tirrell's circuit-breaker and described means of operating it* with *known equivalent* gas-cock mechanism. Clough *v.* Barker, 106 U. S., 177.

Accordingly, if the original patent was a pioneer, or if the claim be limited to *known equivalent* mechanism, infringement of claims 2 and 4 is also evident.

In considering the state of the art we have shown that various kinds of gas-cocks were old (see p. 13), and that mechanism for directly opening a gas-cock, or opening a gas-cock by a single impulse, was, prior to the date of the invention of the reissue patent in suit, a known equivalent for mechanism whereby the opening of the gas-cock would be brought about by a step-by-step movement. No distinction, therefore, can be made in considering the question of infringement, with reference to the particular means for opening the gas-cocks which were *shown* in the reissue patent.

Professor Brackett says that he finds *no* difference between the mode of operation of appellee's circuit-breaker and that of re-issue claim 5; and no *essential* difference between them as to mechanism (Ints. 23–24, p. 17). Questioned as to both the mode of operation and the construction of appellee's burner,

in comparison with the *entire* apparatus covered by re-issue claim 4, he says:

"A. I find in the apparatus alluded to as defendant's burner, a circuit-breaker located at the gas-burner, an armature-lever which can open the gas-cock, and a second similar one which can close it—the one which opens it being adapted to operate the circuit-breaker so as to produce a spark at the tip of the burner; the armatures are operated by electro-magnets, one of which is in the same circuit with the circuit-breaker. There is also a gas-valve, as already implied, which can be turned through a small arc by a rocking motion produced by the armature lever, the motion being sufficient to admit or turn off the gas. The armature and the lever in this apparatus are both combined in one piece of metal, constituting, as I have called it, an armature lever. The circuit-breaker is not continuous with the armature-lever, but arranged so as to be carried by it a small distance only, near the end of its motion toward the magnet. In all essential particulars, the apparatus set forth in claim 4 is found in the burner shown me as defendant's burner; likewise, in all essential particulars the operation of one would be like that of the other, if the apparatus set forth in claim 4 were constructed in accordance with the requirements of said claim." (p. 17, Int. 25. See also Cross-Int. 69, p. 25.)

As to claim 2 there can be no question saving as to the limitation to a lever as an element, and clearly this is not serious in view of the fact that the appellee's burner has a lever and differs only in that this lever is of another kind or order.

Appellee's counsel, in cross-examination, indicates the line of his defence by questions concerning the switching mechanism, the identity of the claims, the use of the invention for burners in series, the *continuous* combination of armature and circuit-breaker, the effect of "soldering together" the electrodes, etc.; but complainant's expert only elaborates his views expressed on direct-examination. He says substantially that the inventor expressly refers "to any use for which the apparatus may be adapted;" that although a rotating gas-cock is shown in the drawings, the *claims* of the original are not thus "specific" but "would admit some variation in the construction," that various kinds of gas-cocks were known (p. 13), that a rotating gas-cock operating by a step-by-step movement was the known equivalent of a gas-cock which is opened directly by one impulse, that the switching mechanism was old and may be omitted in the case of a single light, that for lighting a burner

out of sight by means of the rachet-wheel and pawl there would not be any practical difficulty in ordinary use, and although a better arrangement might be possible, it would still "perform its office with satisfaction" (Cross Int. 54, p. 22). It may be remembered that Gardner suggested graduating his ratchet-wheel in 1857 (see p. 133) and in 1866 (see p. 98). This witness shows that if the electrodes are soldered together the ratchet-wheel and pawl burner could not turn on the gas, while appellee's burner could do so, but that in neither case *could the gas be lighted*, which defect would be equally fatal, whether the gas was or was not turned on, and take the apparatus "out of the category of electric lighting apparatus" (Cross-Ints. 60–64–66, p. 24) and that although in appellee's burner the circuit-breaker is not *attached* to the armature it is "so arranged as to be carried by the armature near the end of its stroke," and that, in the case of defendant's burner, "put in strict mechanical language we have the armature acting as a lever of the third order upon the movable electrode."

The testimony of appellant's experts is of little weight in view of their disagreement, and of their failure to deny or criticise the position taken by Prof. Brackett as to the meaning of the first claim of the original patent, and of their failure to deny or criticise the position taken by Prof. Brackett.

On rebuttal, Prof. Brackett's attention was specifically called to the testimony of appellee's experts.

He (p. 56) explains the differences by which Prof. Morton (p. 31), seeks to distinguish the Tirrell burner of 1880 (exhibit Pinkham burner) from the invention shown in the re-issue, No. 9,743, as immaterial upon complainant's construction of the original and re-issue patents.

In his observations (p. 59 *seq.*) upon Mr. Freeman's testimony as to the Crockett burner, he says (p. 60).

"Some minor points upon which he (Freeman) insists do not appear to me to be of sufficient importance to be taken into account, *much less* to form a ground for discrimination, in accordance with which it may be claimed that the apparatus embodies anything novel, and not embraced in the claim of the original and re-issue patent."

"One thing is substantially the same as another if it performs substantially the same function in substantially the same way to obtain the same result."

Machine Co. *v.* Murphy, 97 U. S., 120.
Clough *v.* Barker, 106 U. S., 166.
Cantrell *v.* Wallick, 117 U. S., p. 695.
Morley Mch. Co. *v.* Lancaster, *ante.*

In the latter cases it was held that even if the defendant's device included patentable improvements, it might infringe.

Judge Wheeler, in the New York case, had no difficulty on the question of infringement, and Judge Colt followed Judge Wheeler except as to the claim which was before Judge Colt, but not before Judge Wheeler.

Conclusion.

Tirrell, or his assignee of patent 130,770 had the right, under the statute, to re-issue the same upon either or both of two grounds, viz:

(*a.*) If claim 1 meant only a "circuit-breaker", it covered more than the patentee had a right to claim as new.

(*b.*) Claim 1, if obscure, could be made more clear and certain.

Claim 2 was meaningless if claim 1 was invalid, or needed erasing or restating; and a re-issue was necessary to cover what the inventor in his original patent attempted and intended to claim, even if no more.

The inadvertence, accident and mistake on the part of both the inventor and the government justified reformation of the instrument, in harmony with the original intent.

The inventor's attempt and intention are to be discovered by first determining, in view of the state of the art, what part of the field was in 1872 open to him; and then determining how much of this field, so open, falls within his attempt and inten-

tion as revealed by a proper construction of his original and re-issue specification and claims.

What was thus open to him, and what he did so intend and attempt to protect by his original patent, was the use of a single electric circuit for three purposes, by means of (1), the combination of the circuit breaker at the burner, the wire which brings the current, a magnet energized by said current, an armature moved by said magnet, and adapted for actuating both the gas cock and the circuit breaker; the wire, the magnet and the circuit breaker, all being in a single circuit; and (2) in combination with the above, a lever properly formed and connected with said armature, and a gas-cock connected with said lever.

What was novel with him was *not* his step-by-step movement, nor his switching mechanism, not *any* single element (unless in form), but the *embodiment of a new mode of operation*, whereby means, *old* individually, were organized into an entity collectively new, and capable of being claimed not only as an entirety, but also in combinations less than the whole. This was evidently *intended* to be done in the original.

Re-issue claim 5 correctly expresses the first intended combination; and re-issue claims 2 and 4 correctly express said second intended combination. Defendant's apparatus contains the combination of elements, attempted to be protected by said original claim 1, and protected by said re-issue claim 5. It also contains the combination of elements attempted and intended to be claimed in original claim 2, and covered by re-issue claims 2 and 4, unless these claims are to be limited to a ratchet wheel and pawl mechanism arrangement for opening the gas-cock. But these claims should not be so limited, because defendant's burner contains devices which were known equivalents for such subsidiary parts in 1872.

It is respectfully submitted that the decree of the Circuit Court should be reversed.

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EDWIN H. BROWN.
of Counsel for Appellant.

Office Supreme Court U. S.
FILED,
MAR 13 1891
JAMES H. McKENNEY,
CLERK.

Supreme Court of the United States.

OCTOBER TERM, 1890.

No. 232.

THE ELECTRIC GAS LIGHTING COMPANY, APPELLENT,

vs.

THE BOSTON ELECTRIC COMPANY.

BRIEF FOR BOSTON ELECTRIC COMPANY,

JOHN E. ABBOTT,
JOHN L. S. ROBERTS,
Counsel for Defendant.

Supreme Court of the United States.

OCTOBER TERM, 1890.

No. 232.

THE ELECTRIC GAS LIGHTING COMPANY, APPELLANT,

vs.

THE BOSTON ELECTRIC COMPANY.

BRIEF FOR BOSTON ELECTRIC COMPANY.

This is an appeal from a decree of the Circuit Court for the District of Massachusetts dismissing, with costs, a bill brought by The Electric Gas Lighting Company for infringement of reissued letters patent No. 9743, dated June 7, 1881, granted to Jacob P. Tirrell, assignor by mesne assignments to the Franklin Electric Gas Lighting Company, for improvements in electrical apparatus for lighting street lamps. The application for the reissue was filed February 17, 1881. A certified copy from the files of the Patent Office of the file-wrapper and contents in the matter of this reissue, is an exhibit in this suit. (*Record*, pp. 77-88.) The original patent, numbered 130,770, was granted to Tirrell, and dated August 20, 1872.

Infringement is alleged of the second, fourth and fifth claims of the reissue. The defences set up in the answer are prior use, want of novelty and of patentability, invalidity of the reissue, and non-infringement.

The alleged infringing apparatus is constructed under letters patent No. 281,345, granted July 17, 1883, to Charles H. Crockett, assignor to the Boston Electric Company. (*Record*, p. 64, Int. 10.)

The only difference of any consequence whatever between the original patent No. 130,777 and the reissue, is in the claims. The drawings differ only as to scale.

The specification is as follows. Words in the original specification which are omitted in the reissue are enclosed in brackets, and words added in the reissue are printed in italics. Small letters designating parts of the drawings are printed in italics in the specifications of both original and reissue.

"Be it known, that I, JACOB P. TIRRELL, *a citizen of the United States*, [of Charlestown], *residing in West Somerville*, in the County of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Electrical apparatus for Lighting Street-Lamps, &c., and *I do hereby declare* that the following is a full, clear, and exact description of the same, reference being had to the accompanying plates of drawings.

This invention relates to that class of electrical apparatus for lighting street lamps in which the current is successively thrown into the magnet at each burner one after another; and under this invention the circuit-breaker is located at the burner, and, by the direct action of the current through the magnet located at the burner, the circuit breaker and the valve to let on or turn off the gas are both operated, and the current, after the opening or closing, as the case may be, of the valve to one burner, is completely cut off from the magnet of such burner and thrown into the magnet of next burner, and so on.

In the accompanying plates of drawings the present invention is illustrated.

In Plates 1 and 2, Figures 1 and 2 are elevations from different sides. In Plate 3, Fig. 3 is a partial plan view and horizontal section; Figs. 4 and 5, detailed views.

A in the drawing represents a gas-burner, to which B is the feed pipe, provided with two horizontal platforms, C and D, for carrying the apparatus of this invention; E, a U magnet, horizontally located and secured on the lower platform, C, with the pipe B in and between the legs F of the magnet; G, the armature, properly located with regard to the magnet E and secured to the lower end of an upright lever, H, turning upon a fulcrum at I of the feed pipe B; J, the circuit-breaker, secured in the upper end of the lever H and projecting upwards to the plane of the escape of the gas from the burner; K, a post in upper platform D, and in electrical connection with the earth.

At the upper end of the post K is a horizontal platinum arm, *b*, against which rests the point *a* of the circuit-breaker J when the lever H is at rest; L, a spiral spring applied to lever H to throw back the armature G from the magnet E; O, an upright arm. This arm O, at its lower end, is hung upon a fulcrum, *d*, of an insulator-block, *e*, on platform C, and at its upper end it is in a position to bear against the periphery of a sector-wheel, *f*, fixed to the spindle *g* of valve in gas-pipe B; *c*, a bent spring applied to arm O to hold it against the sector-wheel *f*, and when escaping from the periphery thereof, to swing it on its fulcrum. The arm O at P, between its two ends, is insulated.

h is a finger piece projecting horizontally from lower end of arm O. This finger-piece *h*, at its outer end, lies in a position between the two pins *l* and *m*, projecting horizontally one above the other from the block *e*. The lower pin *l*, extends wholly through the block *e*, and similarly projects therefrom upon its other side, being there lettered as l^2. The upper pin, *m*, only enters the block; but on the opposite side of the block thereto a similar pin, m^2, is located, also only entering the block.

Q is an arm similarly constructed, arranged, and hung on the block *e*, to the arm O. This arm Q is in position to bear upon the periphery of a sector-wheel, *n*, fixed to the gas-valve spindle *g*, and for its finger-piece h^2 to lie in and between the projecting pins l^2 and m^2 of the block *e*. The sector-wheel *n* is back of the sector-wheel *f*. The two sector wheels *f* and *n* are of equal diameter, of an equal length of arc—that is, a half of a circle. The two together complete the circumference. The relative location of the sector-wheels *f* and *n* on the valve-spindle is such that with the arm O on the periphery of the sector-wheel *f* the arm Q will be off the periphery of its sector-wheel *n*, and vice versa; and the purpose of the said sector-wheels is to turn their respective arms O Q so as to bring about a bearing between their respective finger-pieces hh^2 and the lower pins ll^2 and also to allow the springs applied to the said arms O Q to react and bring their finger-pieces into contact with the upper pins mm^2.

R *is* a ratchet-wheel secured to gas-valve spindle back of inner sector wheel, *n;* and S a spring pawl hung to lever H and arranged from the movement of such lever to act upon the ratchet-wheel R to turn it in the direction of the arrow, Fig. 1, Plate 1. In lieu of a ratchet-wheel, a friction wheel and clutch may be employed, such as shown in Fig. 5.

M. and N *are* wires leading from the electric battery employed. The wire M is to let on and the wire N to shut off the gas at the burner A. The current is thrown into the one or the other of said wires by means of a double switch such as is employed ordinarily in

electrical gas-lighting apparatus, and, therefore, needs no particular description herein. The wire M connects with the arm O and the wire N with the arm Q. T *is* a wire connecting lower pin, *l*, with magnet E; and U a wire connecting magnet with circuit-breaker J. V and W *are* wires respectively connected with upper pins *m* and m^2, from which they are to lead to the next burner, and to such burner become the letting-on and turning-off wires, as the wires M and N to the burner A.

The position of the several parts composing the mechanism hereinabove described is at all times, if at rest, substantially that shown in Fig. 1, Plate 1, and only differs therefrom in any condition of rest, in the relative position of the two arms O Q, according as the one or the other is bearing on its respective sector-wheel *f or n*. By the shown positions of the two arms O and Q, the finger-piece *h* of arm O is against the lower pin *l*, and the finger-piece h^2 of arm Q against the upper pin m^2 of block *e*. This relative contact with the pins *l* l^2 *m* m^2 of the finger-pieces to the two arms is always maintained, they never being both at the same time in contact with the lower pins *l* l^2, or the upper pins *m* m^2, but always the one with a lower pin and the other with an upper pin alternately.

[With the arms O and Q in the relative positions described and shown, if now] *If, now, with the arms O and Q in the relative positions described and shown*, a current of electricity be thrown into the wire M, (which, as stated, is the letting-on wire), it is obvious it will pass into the magnet, (the connection being through arm O, finger-piece *h*, pin *l*, and wire T,) thence to the circuit-breaker J; and then, as the circuit is complete, the armature G will be drawn toward the magnet, turning its lever H on its fulcrum, which carries the circuit-breaker J beyond the end of the platinum arm *b*, breaking thereby the circuit and emitting an electric spark. This breaking of the circuit destroys the attractive force of the magnet, and leaves the lever H to be pulled backward by the spring L, which backward movement of the lever completes the circuit by bringing the circuit-breaker into contact with the platinum arm *b*, when another attraction of the armature G occurs, again breaking the circuit, emitting a spark, and so on, as before. By this alternate forward and backward movement of the lever H, the ratchet-wheel R on gas valve spindle is intermittently rotated, carrying with it the valve spindle *g*, and sector-wheels *f n*. If this rotation of the valve-spindle *g* be continued sufficiently, the periphery of the sector-wheel *f* will be carried beyond the arm O, leaving it free for its spring to act upon it, and thus to throw its finger-piece *h* out of contact with the lower pin *l*, and into contact with the upper pin *m*, and the periphery of the sector-wheel *n* will be brought to bear upon the arm Q, throwing its finger-piece h^2 out of contact with the upper pin m^2, and in contact with the lower pin l^2.

With the movement of the sector-wheel *f* beyond its arm O, and of the sector-wheel *n* on to its arm Q, as above described, results have been effected as follows: First, the gas-valve or stop-cock has been opened to its fullest extent, and as, at each stroke of the lever H, caused by the successive attraction of the armature, the circuit was broken and a spark emitted, it is obvious the gas necessarily must have been lighted; second, the current of electricity through wire M is cut off from the magnet E and thrown into the wire V leading to the magnet of the next burner, and which, as before stated, is the letting-on wire to such burner; third, a connection has been established between the magnet E and the shutting-off wire N, so that, when desired to shut off the gas from the burner A, the operator has only to make the necessary connection between battery and shutting-off wire. The connection between *the* shutting-off wire N and magnet is through arm Q, its finger-piece h^2, pin l^2, and wire T.

In shutting off the gas at the burner, the operation of the parts is precisely similar to the letting-on of the gas, and therefore needs no particular description; and on its completion the arm Q escapes from its sector-wheel *n*, and the arm O passes onto its sector-wheel *f*, re-establishing the connection between letting-on wire and magnet, as before. Completing the shutting-off of the gas at one burner throws the current into the wire W leading from such burner A to the next burner, which wire W to the said next burner is the shutting-off wire.

In Fig. 4, the valve in gas-pipe is shown in detail, and it is such that in a half-turn of the spindle *g* the gas will be let on, and, continuing the turn, shut off.

The location of the circuit-breaker at the gas-burner is such that, as it breaks the circuit by escaping from the platinum arm *b*, the spark emitted will be sufficiently near to the escaping gas [as] to ignite the same, and it is desirable that the movement to let on the gas should be so divided as to emit a sufficient number of sparks to insure the lighting of the gas.

I do not claim turning on and off gas by means of a step-by-step motion, as such is not my invention.

Having thus described my invention [I shall state my claims] *what I claim is* as follows:"

It will be seen that the specification of the reissued patent is precisely the same as that of the original, with the exception of the trivial verbal changes noted above and which were not required to be made on account of any defects or insufficiencies of the original specification.

The sole object of the reissue was to expand the claims. This will be obvious by comparing the claims of the original patent and of the reissue; and for convenience of comparison these claims are printed side by side below:

ORIGINAL.	REISSUE.
(1.) "A circuit breaker located at the burner, and operated automatically, substantially as described.	(1.) "In an apparatus for lighting gas by electricity, the combination of two wires through which currents of electricity are passed, an electro-magnet electrically connected therewith and attracting an armature which actuates mechanism, substantially as described, for automatically turning on the gas and lighting the same by an electric spark at the tip of the gas burner, and also for turning off the gas to extinguish the light, substantially as described.
(2.) In combination with the above a lever, adapted and arranged to open and close the stop-cock or valve of the burner, and carrying the circuit breaker, substantially as herein described.	(2.) In an apparatus for lighting gas by electricity, the helix of an electro-magnet connected at one end with the wire through which the current of electricity is passed, and at the other end with a circuit-breaker located at the gas-burner, so arranged that the current of electricity is passed to the circuit-breaker through said magnet, attracting an armature-actuating mechanism operating automatically to turn on the gas and light the same by the effects of the primary sparks made at the tip of the burner from said magnet in the circuit.
(3.) The arms O Q, sector wheels *f n*, pins *l* l^2 *m* m^2, wires M N, magnet E, lever H, carrying armature G, circuit breaker J, and pawl S, and the ratchet wheel R, all combined and ar-	(3.) The arms O Q, sector-wheel *f n* pins *l* l^2 *m* m^2, wires M N, magnet E, lever H, carrying armature G, circuit-breaker J, and pawl S, and the ratchet-wheel, all combined and arranged

ranged together and applied to a gas burner, for operation, substantially as and for the purposes set forth."

together and applied to a gas-burner for operation, substantially as and for the purposes set forth.

(4.) In an apparatus for lighting gas by electricity, in combination with a circuit-breaker located at the gas-burner, a lever adapted and arranged to open and close the stop-cock or valve of the burner, and carrying the circuit-breaker, substantially as herein described.

(5.) In an apparatus for lighting gas by electricity, the combination of a wire through which a current of electricity is passed, actuating mechanism for letting on the gas, an electro-magnet electrically connected with said wire, an armature operated by said electro-magnet, mechanism actuated by said armature, breaking the circuit at the burner-tip, and producing there an electric spark or sparks for lighting the gas, the whole operating automatically.

(6.) In an apparatus for lighting gas by electricity, the combination of two wires through which currents of electricity are passed, actuating mechanism for both letting on and turning off the gas by substantially the same means, an electro-magnet electrically connected with said wires, an armature operated by said electro-magnet, mechanism actuated by said armature for breaking the circuit at the burner-tip and producing there the spark or sparks for lighting the gas, the whole operating automatically, substantially as described."

Still more significant are those claims which were made when the application for the reissue was filed, and which were erased after objection to their allowance was made by the Patent Office. Reference will be more fully made to these claims under the heading of "History of the Reissue."

STATE OF THE ART.

Prior to the invention for which patent No. 130,770 was obtained by Tirrell, a large number of patents had been granted for electric gas-lighting apparatus, in which the electric current generated by a battery was utilized for turning a gas-cock and igniting the gas, and for extinguishing the gas after its ignition. Such apparatus is commonly called "automatic," to distinguish it from electric gas-lighting apparatus in which the gas-cock is turned by the hand of the operator, and the electric current is used only to ignite the gas. Some of the earlier patents which show the state of the art are exhibits in this case. As to the state of the art, see also testimony of *Prof. Brackett*, appellant's expert, (*Rec.*, pp. 11-13, *Int.* 6, and p. 54, *Int.* 1,) and testimony of *Dr. Henry Morton*, (*Rec.*, p. 28, *Int.* 5.)

One of the most successful of these earlier inventors was Samuel Gardiner, Jr. His apparatus was used as early as 1866 for lighting the Capitol at Washington, and continued to be so used for more than ten years. This apparatus was examined and reported upon by Prof. S. F. B. Morse and three other experts. See *Knight's Am. Mechanical Dictionary*, p. 1315. Several of Gardiner's patents are exhibits in the present suit, the earliest one being No. 18,945, granted in 1857. In this patent Gardiner says: "I do not claim to be the discoverer of the fact that illuminating gas may be ignited by means of electricity; nor do I claim to be the first to suggest the lighting of a street of gas-lamps simultaneously by means of electricity. A method of doing this is described on page 125 of the Amer-

ican Year Book of Facts, 1851, and alleged to be the invention of M. Villatte."

Prior to August 20, 1872, the date of the original patent to Tirrell, nearly one hundred patents had been granted by the United States for electric gas-lighting apparatus. The purpose of most of this apparatus was the lighting and extinguishing of street lamps by electricity. Until about 1879, it was not supposed that the automatic electric gas-lighting apparatus would be in any demand for house-lighting or for in-door use, except where the gas-burners were at a great height, as in some halls and churches; but since 1880 the "automatics" have been and now are extensively used for house-lighting, while they have been entirely abandoned for street-lighting.

The ground had been so occupied prior to 1872, that no space was left for a foundation patent for automatic electric gas-lighting apparatus.

Two different classes of such apparatus have been made; one employing a "step-by-step" motion, in which by successive electric impulses the gas-cock is rotated, always in the same direction, both for turning on and for turning off the gas; the other, in which, by a single electric impulse, a rocking gas-valve is turned in one direction to let on the gas and in the reverse direction to extinguish the gas. In apparatus of the first class, a single electro-magnet, a ratchet-wheel and pawl, a gas-cock rotating always in the same direction, and switching mechanism are used; and the use of such switching mechanism to automatically divert the electric current to the next burner is absolutely necessary, for without such switching mechanism the gas-cock would continue to rotate, alternately turning on and off the gas, and it would be impossible for the operator to stop the movement of the gas-cock at the desired point. Apparatus of the first-class is adapted and was intended to light a series of burners. In apparatus of this class, Tirrell testifies (*Rec.*, p. 48) that the switching mechanism is absolutely neces-

sary. In every ratchet-wheel "automatic," switching mechanism is not only used, but it *must* be used to make the apparatus effective.

In apparatus of the second class, there are two electro-magnets. There is no ratchet-wheel nor pawl, nor gas-cock rotating always in the same direction. There is no switching mechanism, nor any equivalent for it, nor any necessity for it. The apparatus of this class is neither adapted nor intended to light a series of burners, but one burner only. The alleged infringing burner belongs to this second class.

TIRRELL'S CONNECTION WITH AUTOMATIC ELECTRIC GAS-LIGHTING APPARATUS.

Jacob P. Tirrell, to whom the original patent No. 130,770 was granted, had his first experience with electric gas-lighting apparatus in 1869, when he was employed by Edwin E. Bean to make a model of the apparatus for which patent No. 90,629, was granted to Bean; and in the following year he assisted Frank Bean in constructing some fifteen electric gas-lighting burners which were applied to street-lamps by the side of Boston Common. The following patents were granted to Tirrell for automatic electric gas-lighting apparatus: Nos. 121,301 and 121,302, each dated Nov. 28, 1871; No. 130,770, dated Aug. 20, 1872; No. 184,807, dated Nov. 28, 1876; No. 206,057, dated July 16, 1878; and Nos. 230,589 and 230,590, each dated July 27, 1880, (*Rec.* p. 47).

When the inventions were made for which the first two and the last two of these patents were granted, Tirrell was in the employ of George F. Pinkham, to whom the patents were issued as Tirrell's assignee, and Pinkham subsequently assigned these four patents, for New England, to the Boston Electric Company, (*Rec.* p. 51). Dr. Cutler, a witness for complainant, testifies (*Rec.* pp. 74–76,) that in 1872 patent No. 130,770 was

sold to the United States Gas-Lighting Co., which company was in 1879 succeeded in business and in ownership of the patent by the Franklin Electric Gas-Lighting Co.; that Cutler was an officer and stockholder of both companies and that he had been a stockholder in the Electric Gas-Lighting Co.; that in 1879 he obtained patent No. 220,704, for an automatic lighter, as to which he says (*Rec.* p. 74): "This patent was an electrical success, but was impracticable in the matter of time required for the gas to reach the breaker at the tip;" that the United States Gas-Lighting Co., employed Tirrell regularly for the first four or five years subsequent to 1872 and "later, by odd jobs, a portion of the time;" that the Franklin Electric Gas-Lighting Co. ceased to do business in 1881, and that it did not put into practical use any burners for automatic lighting of gas by electricity either in 1880 or in 1881; and that it was the United States Gas-Lighting Co., which put into use, principally under the supervision of Tirrell, the burners testified about by Cutler in answer to the fourth direct question (*Rec.* p. 74).

As to burners like "Defendant's Exhibit No. 1," (being the apparatus described and shown in patent No. 130,770,) Tirrell says, (*Rec.* p. 48):

"They were used for street-burners. They were not used after the experiment at Chelsea for that purpose, or for any other, so far as I know."

Tirrell further says on page 48 that "automatics," were first used for house-lighting in 1874 or 1875; that the apparatus so used was constructed after his patent No. 184,807; that this apparatus was only used in three instances; and that it was not until about 1878 or 1879 that there began to be any considerable use of the automatics for house-lighting, when the apparatus of patent No. 230,590 was first introduced.

Patent No. 121,301 to Tirrell is a manifest outgrowth from Bean's patent. It employs a ratchet-wheel and pawl actuated

by successive electric impulses to rotate the gas-cock for turning on and off the gas, an automatic circuit-breaker in proximity to the gas-burner, and automatic switching mechanism for shunting the electric current to the next apparatus in the series when the gas-cock has been fully opened or fully closed, as the case may be. In these general respects, it is like the apparatus described in the reissued patent; but it differs from that in having a small auxiliary burner by the side of the main burner, and in having an additional electric circuit. As to his invention Tirrell says in the specification of patent No. 121,301: "My invention relates to that class of apparatus in which two sets of wires are employed alternately, one for letting on and the other for shutting off the gas; and it consists in the peculiar construction of the mechanism by which the gas is let on and shut off and the electric current caused to pass to the next apparatus, one apparatus only at a time being included in the electric circuit; and my invention also consists in the application to an electrical apparatus for lighting and extinguishing gas, of a circuit breaker operated by the armature of the electro-magnet and placed in close proximity thereto, whereby the armature is set in motion by the electric current without the employment of a key or clock-work mechanism at the central station, as has heretofore been required; and my invention also consists in the combination of an auxiliary burner with the main burner and an electric spark-generating mechanism, by which construction I am enabled to permanently place the spark-generating mechanism out of the reach of the flame issuing from the main burner; and my invention furthermore consists in arranging the primary coils for producing the sparks within the apparatus and in close proximity to the burner, which facilitates the construction of the apparatus and lessens its cost."

From a statement later in the specification, it appears that these primary coils, (being the insulated wire surrounding the magnet,) had been placed by Bean beneath the lamp-post.

In the apparatus of this patent, a single electro-magnet is used for rotating the ratchet-wheel attached to the gas-cock, so as to turn on or to turn off the gas, and switching-mechanism is

also employed to automatically divert the electric current to the next apparatus at the instant when the gas-cock has reached the desired position.

Patent No. 121,302, also dated Nov. 28, 1871, was granted to Tirrell for automatic electric gas-lighting apparatus. The apparatus of this patent does not contain any ratchet-wheel for moving the gas-cock. The invention is described in the specification as consisting "in the employment of two electro-magnets, operated alternately, in combination with a mechanism connected therewith for letting on and shutting off the gas, and operating a switch or equivalent device for breaking the circuit through either one of the electro-magnets and causing the current to pass to the next apparatus, one apparatus only at a time being included in the electric circuit; and my invention also consists in certain details which will be fully described hereafter." Near the end of the specification the patentee says: "By the employment of two electro-magnets, as above described but a single motion of the shaft D, to which the armatures are secured, is required to light or extinguish the gas, which operations can, consequently, be performed in a much shorter space of time than where a ratchet-wheel revolved by a single electro-magnet is employed, while the mechanism does not require to be made with as much accuracy and is, consequently, less expensive and less liable to get out of order."

In each of these patents granted to Tirrell in 1871 there is a circuit-breaker located at the auxiliary burner and operated automatically. It would manifestly require no invention to locate the circuit-breaker at the main burner and there operate it automatically.

The two patents show clearly that Tirrell recognized the state of the art in 1871 to be such that invention in automatic electric gas-lighting apparatus was limited to the specific mechanism described and claimed, or to its known equivalent. The objections to the ratchet-wheel apparatus are pointed out by Tirrell in that part of the specification of patent No. 121,302 which we have just quoted; and later experience has shown

that these objections are well-founded. August 20, 1872, patent No. 130,770, (the original of the reissue in suit,) was granted to Tirrell. This shows a ratchet-wheel apparatus, containing a single electro-magnet. It is clearly an outgrowth from patent No. 121,301. It dispenses with the auxiliary burner and locates the circuit-breaker at the main burner.

Upon an application filed January 14, 1876, a patent for electric gas-lighting apparatus was granted to Tirrell Nov. 28, 1876, numbered 184,807.

In the specification of this patent he says: "This invention relates more particularly to the electrical gas-lighting apparatus embraced and described in the schedule annexed to the letters patent of the United States issued to me, dated August 20, 1872, numbered 130,770; and it consists in certain improvements in the construction, combination, and arrangement of the parts embraced in said apparatus."

Upon an application filed October 18, 1877, a patent was granted to Tirrell, July 16, 1878, and numbered 206,057, for a further improvement "in the construction, connection, and arrangement of the several parts" of the apparatus described in patent No. 130,770. This is evident from the second and third paragraphs of the specification of patent No. 206,057, as well as from the drawings of the patent. In cross-examination of George F. Pinkham, (*Rec.* p. 53,) counsel for complainant inquired (*Cross-Int.* 19): "Are you familiar with the improvements on letters patent No. 130,770, described in letters patent of the United States Nos. 184,807 and 206,057," etc.?

July 27, 1880, upon applications filed May 22, 1880, two patents for automatic electric gas-lighting apparatus were granted to Tirrell, assignor to George F. Pinkham, numbered respectively 230,589 and 230,590. The first of these two patents is for a ratchet-wheel apparatus, containing a single electro-magnet and switching mechanism, and in which the gas-cock, rotating always in one direction, is opened and closed by

a step-by-step motion and by successive electric impulses. In the specification of this patent Tirrell says:

"My present invention relates to *that class of apparatus in which two separate wires are employed, one for letting on and lighting and the other for shutting off the gas.* * * * My invention consists of a combined circuit-breaker and switch of peculiar construction, operated automatically by a cam connected with the rotary gas-valve, by means of which the electric current is caused to pass alternately by separate wires to the electro-magnet for the purpose of letting on and simultaneously lighting the gas and shutting off the same, the circuit being completed, as usual, by means of keys or pressure-buttons, which are operated alternately to let on and shut off the gas."

Patent No. 230,590 is for an apparatus having two electro-magnets, containing neither ratchet-wheel nor switching mechanism, and in which the gas-cock is opened or closed, as may be desired, by a single electric impulse. In this apparatus, sparks are produced at the burner-tip after the gas-cock has been opened, so long as the operator keeps the electric circuit closed, and without further movement of the gas-cock. This construction is of great advantage, because it insures the lighting of the gas by producing a succession of sparks at the burner-tip after the gas-cock has been fully opened. This advantage was not possessed by any other apparatus at the date of this patent, and this patent was held valid by Judge Colt in the case of *Boston Electric Co.* v. *Fuller et al.*, 29 Fed. Rep. 515, which will be fully referred to hereafter. Burners embodying the invention of patent No. 230,590 were the first which operated successfully in practical use. (*Tirrell*, p. 48; *Pinkham*, pp. 52, 53). All of the earlier "automatics" were adapted and intended for lighting street-lamps, or a series of burners. The apparatus of patent No. 230,590, is not adapted to light a series of burners, but was designed for house-lighting, where each burner must be capable of being lighted or extinguished independently of any other burner.

The use of "automatics" for street-lighting was abandoned as early as 1877, and had never been extensive or successful. Until his employment by Pinkham in 1878 or 1879, Tirrell had directed his efforts to perfecting the street-lighting apparatus. It was not until Pinkham hired him in 1879, that there was any demand for the house-lighting apparatus, and, to meet this demand, Tirrell made the invention described and shown in patent No. 230,590.

History of the Reissue.

Within a few months after Tirrell made and sold to Pinkham the inventions for which patents Nos. 230,589 and 230,590 had been granted, and after the apparatus of patent No. 230,590 had been put into successful and extensive use by the Boston Electric Company, and by other parties who had acquired the right to use the invention from Pinkham, to whom Tirrell had sold it, Tirrell was induced by the Franklin Electric Gas-Lighting Co. to apply for a reissue of patent No. 130,770. The application for the reissue was filed Feb. 17, 1881. Patents Nos. 121,301, 121,302, 230,589 and 230,590 were then owned by the Boston Electric Company for New England. The record does not disclose who then owned the other two Tirrell patents, No. 184,807 and 206,057, for improvements in the apparatus of patent No. 130,770. When Tirrell applied for patent No. 184,807, nearly four years had elapsed since the granting of patent No. 130,770; and, as previously stated, he says in the second paragraph of the specification of patent No. 184,807:

"This invention relates more particularly to the electrical gas-lighting apparatus embraced and described in the schedule annexed to the letters patent of the United States issued to me, dated August 20, 1872, numbered 130,770; and it consists in certain improvements in the construction, combination and arrangements of the parts embraced in said apparatus."

Tirrell's attention was again specially called to the apparatus of patent No. 130,770 when he applied, October 18, 1877, for patent No. 206,057. Yet it did not occur to him or to any one else, until 1881, that patent No. 130,770 did not claim all that he had invented. Apparatus like that shown in the drawings of the last-named patent had not been manufactured for several years prior to 1881. (*Cutler*, p. 74; *Tirrell*, p. 48; *Pinkham*, p. 53). It had not operated successfully. The apparatus of patent No. 184,807 worked a little better, but it had not been used to any extent. From the testimony of Dr. William C. Cutler, (*Rec.* pp. 73–77), it appears that the Franklin Electric Gas Lighting Co. obtained title to patent No. 130,770 from the United States Gas Lighting Co. in 1878 or 1879; that Cutler was an officer and stockholder of both companies during their whole existence, and that he had been a stockholder in the Electric Gas Lighting Co.; that the Franklin Electric Gas Lighting Co. ceased to do business in 1881; and that this last-named company never put into use any automatic electric gas-lighting burners after the invention of the apparatus described in patent No. 230,590. Dr. Cutler, on cross-examination, testified as follows, (*Rec.* p. 76):

"*Cross-Int.* 13. When was the Franklin Electric Gas-Lighting Company organized and when did it cease to do business?

Ans. I can't be certain as to dates, but think it was organized in 1877 or 1878. I think it ceased to do business in 1881.

Cross-Int. 14. Did that company apply any burners for automatic lighting of gas by electricity in either of the years 1880 or 1881, except for experimental use only?

Ans. My impression is that at about that time work was being done by a licensee of the company, William R. Nutting. Of this I will not be certain.

Cross-Int. 15. Are you positive that said Nutting was ever a licensee of said Franklin Company?

Ans. I think he was not, but think he put in a few burners for them."

Now Nutting was one of the incorporators of the Boston Electric Company, and he never did any work for any of Dr. Cutler's companies.

Dr. Cutler gave the following testimony in direct examination, (*Rec.* p. 75):

"*Int.* 6. If you know with what purpose and intention application was caused to be made by the Franklin Electric Gas-Lighting Company for a reissue of letters patent No. 130,770, will you please state the same?

Ans. For the reason that we were told that we had no claim for the invention of the turning of the stop-cock and lighting the gas by a single current with one wire in our 1872 patent, and for no other reason."

The assent of the Franklin Electric Gas-Lighting Company to the application for the reissue was signed in its behalf by Dr. Cutler, as president of the company. (*Rec.* p. 78).

The record does not disclose the name of the kind individual who informed the officers of the Franklin Company that the 1872 patent had no claim for what Cutler's "year's study" (*Rec.* p. 74), had led him to believe was the most important feature of Tirrell's invention. Evidently Tirrell was not the informant. In all the years since 1872, in which he had been employed by Dr. Cutler's companies, it had not dawned on him or on the officers of those companies that the 1872 patent did not claim all that he had invented. But after Tirrell had patented and sold to Pinkham the invention for which patent No. 230,590 was granted, and after this apparatus had proved to be practical and efficient, the officers of the Franklin Company saw a great light, and they induced Tirrell to apply for a reissue of the 1872 patent from no other conceivable motive than to expand the claims of that patent so as to cover the invention for which patent No. 230,590 had been granted. The real purpose of the reissue is not so plainly revealed in the application for the reissue as in Cutler's testimony in this suit; but, in spite of the confused and nebulous claims in this application, the design of the reissue is apparent.

Tirrell's oath to the application for the reissue states that the original letters patent are inoperative "by reason of a defective

specification, and that such defect consists *in the omission of claims* for the different combinations of wires, electro-magnets, armature attracted thereby, mechanism actuated by said armature, circuit-breaker, and other elements operating automatically *as specified and claimed in the claims of this application.*" *(Rec.* p. 83.*)*

When first filed, the application for reissue contained the following eleven claims:

1st. In an apparatus for lighting gas by electricity, a wire through which a current of electricity is passed, having electrical connection with an electro-magnet attracting an armature, which armature actuates mechanism operating automatically to turn on the gas and light the same by an electric spark or sparks at the tip of the gas-burner.

2nd. In an apparatus for lighting gas by electricity, a wire through which a current of electricity is passed, having electrical connections with an electro-magnet attracting an armature, which armature actuates mechanism operating automatically to turn off the gas and extinguish the light.

3rd. In an apparatus for lighting gas by electricity, two wires through which currents of electricity are passed, each wire electrically connected with the same electro-magnet, attracting an armature, which armature actuates mechanism operating automatically to turn on the gas and light the same by an electric spark or sparks at the tip of the gas-burner, and also to turn off the gas and extinguish the light.

4th. In an apparatus for lighting gas by electricity, two wires through which currents of electricity are passed, which wires are electrically connected with an electro-magnet, attracting an armature, which armature actuates mechanism operating automatically to turn on the gas and light the same by an electric spark or sparks at the tip of the gas-burner, and also to turn off the gas and extinguish the light.

5th. In apparatus for lighting gas by electricity, a circuit-breaker located at the burner and operated automatically, substantially as described.

6th. In an apparatus for lighting gas by electricity, the helix of an electro-magnet connected at one end with the wire through which the current of electricity is passed, and at the other end with a circuit-breaker located at the gas-burner, so arranged that the current of electricity is passed to the circuit-breaker through said magnet, attracting an armature-actuating mechanism, operat-

ing automatically to turn on the gas and light the same by the effects of the primary sparks made at the tip of the burner from said magnet in the circuit.

7th. The arms O Q, sector-wheels *f n*, pins *l* l^2, *m* m^2, wires M ^{m} N^n, magnet E, lever H, carrying armature G, circuit-breaker J, and pawl S, and the rachet-wheel, all combined and arranged together and applied to a gas-burner for operation substantially as and for the purposes set forth.

8th. In an apparatus for lighting gas by electricity in combination with a circuit-breaker located at the gas-burner, a lever adapted and arranged to open and close the stop-cock or valve of the burner and carrying the circuit-breaker, substantially as herein described.

9th. In an apparatus for lighting gas by electricity, the combination of a wire, through which a current of electricity is passed, actuating mechanism for letting on the gas, an electro-magnet electrically connected with said wire, an armature operated by said electro magnet, mechanism actuated by said armature breaking the circuit at the burner tip and producing there an electric spark or sparks from the effects of the electro-magnet for lighting gas, the whole operating automatically.

10th. In an apparatus for lighting gas by electricity, the combination of two wires through which currents of electricity are passed, actuating mechanism for both letting on and turning off the gas by substantially the same means, an electro-magnet electrically connected with said wires, an armature operated by said electro-magnet, mechanism actuated by said armature for breaking the circuit at the burner tip and producing there the primary or electric spark or sparks for lighting the gas, mechanism actuated by said armature for turning off the gas, the whole operated automatically.

11th. In an apparatus for lighting gas by electricity, a series of electro-magnets connected with a series of gas-burners, so arranged that when a current of electricity is passed through a wire-actuating mechanism for letting on the gas of the first burner to an electro-magnet connected therewith said magnet operates an armature-actuating mechanism operating automatically to turn on the gas of the first burner and light the same by an electric spark or sparks at the tip of the burner, and also to cut off the current of electricity from the first electro-magnet and throw the same into the wire-actuating mechanism for letting on the gas of the next burner."

Of these eleven claims, with the exception of prefixing to the fifth and eighth the words "in an apparatus for lighting gas by electricity," and the substitution in the eighth claim of the words "in combination with a circuit-breaker located at

the gas-burner" for the words "in combination with the above," used in the second claim of the original, the fifth, eighth and seventh claims in the application for the reissue as originally filed are precisely the same, respectively, as the first, second and third claims of the original patent. The remaining eight claims must, therefore, have been intended to embrace some invention not covered by the three claims of the original. Tirrell's oath to the application shows that the new claims are for other combinations of elements than those of the original claims; and Cutler's testimony reveals that the sole purpose of the reissue was to add claims which would include all electric gas-lighting apparatus in which one electric circuit was utilized for turning the gas-cock and igniting the gas. Neither Tirrell, who had been employed for several years subsequent to 1872 by the United States Gas-Lighting Co., and who had during that time obtained two patents for improvements in the apparatus of his 1872 patent; nor Dr. Cutler, who had been the principal officer of the corporations owning the 1872 patent, and who had spent nearly a year in the study of patents and apparatus relating to electric gas-lighting; nor any one else; had discovered that the claims of Tirrell's 1872 patent did not cover his invention, until after Tirrell's 1880 burner had been put into public use.

Under date of March 8, 1881, the examiner in the Patent Office rejected the application for reissue, stating (*Rec.*, p. 84): "The 1st, 2d, 3d, 4th, 5th, 10th and 11th claims are met by applicant's former patent, No. 121,301, Nov. 28, 1871."

Tirrell's attorneys thereupon erased claims one, two, three, four, ten and eleven, inserted a new claim which was finally allowed as the sixth claim of the reissue, and also inserted the following claim:

"1. In an apparatus for lighting gas by electricity, the combination of two wires through which currents of electricity are passed, an electro magnet or magnets electrically connected therewith, an

armature or armatures attached [attracted] by said magnet or magnets, and mechanism actuated by said armature or armatures and operating automatically, whereby the gas is turned on and lighted by an electric spark or sparks at the tip of the gas-burner, and the gas also turned off and the light extinguished, substantially as described."

In the same communication which contained these amendments, Tirrell's attorneys say (*Rec.*, p. 85):

"A reconsideration of claim 2, formerly claim 5, is respectfully requested, as it is almost identically the same as claim 1 of the original. In the former patent of applicant's cited as a reference by the examiner the gas is first lighted at an auxiliary burner, whose flame ignites the gas at the illuminating burner. In the present application the circuit-breaker is located directly at the illuminating burner, no auxiliary burner being used."

Manifestly no invention would be required to locate the circuit-breaker at the main burner. The apparatus would operate in precisely the same way as before, and the auxiliary burner was used only for the supposed advantage set forth in patent No. 121,301.

After the amendment of March 30, 1881, the examiner wrote (*Rec.* p. 86):

"This case has been again examined. *There being but a single magnet and a single armature shown, applicant cannot pluralize these terms as he has done in his amended first claim.* The 1st and 7th claims inserted by amendment March 27 [should be March 30], as well as the 3d (original 6th) claim, are met by Edward E. Bean, 90,629, June 1, 1869.

The 2d (original 5th) claim is met by Morris and Reid, 101,491, April 18, 1870."

On April 29, 1881, Tirrell amended his application by erasing claims 1 and 2, by inserting a claim which is claim 1 of the reissue, and by inserting the following claim:

"2. In an apparatus for lighting gas by electricity, a circuit-breaker located at the top of the burner and operated automatically by means substantially as described."

In communication dated April 30, 1881, the examiner said, *(Rec.* p. 87*)*:

"The present second claim is substantially the same as the original fifth, and is met by Morris and Reid, 101,491, April 5, 1870."

Thereupon Tirrell erased claim 2 by an amendment in which his attorneys say, *(Rec.* p. 87*)*:

"*The application having been amended in conformity with the requirements of the office*, and being a reissue application, an immediate allowance is respectfully requested."

By the erasure of this second claim and of the fifth claim in the original application for the reissue, upon the objections made by the Patent Office, Tirrell conceded that the first claim of the original patent was void. By erasing claim one inserted by amendment of March 30, 1881, upon the objection of the examiner that the apparatus of the original patent showed only a single magnet and a single armature, Tirrell conceded that he was not entitled to a claim for an apparatus in which two magnets or two armatures are used; and the claims of the reissue must, in any event, be held limited to the specific mechanism claimed in the original patent.

When an applicant either for an original patent or for a reissue, erases claims objected to by the Patent Office, such erasure is equivalent to a disclaimer. As this Court said in *Sutter* v. *Robinson*, 119 U. S., 530, 541:

"A comparison of the patent as granted with the application very conclusively establishes the limits within which the patentee's claims must be confined. He is not at liberty now to insist upon a construction of his patent which will include what he was expressly required to abandon and disavow as a condition of the grant."

THE REISSUE IS INVALID.

I.

The law authorizes a reissue only "whenever a patent is inoperative or invalid by reason of a defective or insufficient specification, or by reason of the patentee claiming as his own invention or discovery more than he had a right to claim as new, if the error has arisen by inadvertence, accident or mistake," and prohibits the introduction of any new matter into the specification. *Rev. Stat.*, § 4916.

The original patent was not inoperative or invalid by reason of a defective or insufficient description of the invention, for, with the exception of the claims, the specification of the reissue is the same as that of the original patent; but, after the lapse of nearly nine years, and the issue to Tirrell of patents Nos. 184,807 and 206,057 for improvements in the construction, etc., of the apparatus of patent No. 130,770, and the issue of patents Nos. 230,589 and 230,590, Tirrell's assignee suddenly discovers that the claims made in the 1872 patent are defective—not in expression, for Tirrell repeats them all in his application for the reissue, but in the omission of claims for combinations of wires, electro-magnets, etc., not claimed in the original.

This application for reissue was, therefore, in direct conflict with the statute. It was not made because the patentee had, in his original patent, claimed as his invention "more than he had a right to claim as new," as provided in the statute; for Tirrell's oath declares that the ground of the application is that he had originally claimed *less* than he was entitled to claim.

Unless the fourth claim of the reissue should be construed as covering only the specific mechanism shown and described in the original patent, (a construction which is repudiated by complainant), the reissue is void except as to the third claim,

because its claims are broader than the claims of the original; and it is not pretended that defendant infringes the third claim.

The object of the reissue was to broaden the patent so that it should not be confined, like the original, to the apparatus illustrated in the drawings and described in the specification of that patent; but that it might cover apparatus patented by patents issued subsequent to 1872, and especially the apparatus of patent No. 230,590.

The invention for which patent No. 130,770 was granted is for a combination of elements, all of which, it is admitted, were old and well-known in electric gas-lighting apparatus prior to 1872.

There is no ground for claiming that the five new claims of the reissue equal the first two claims of the original, (the third claim being precisely the same in each,) which does not involve the concession that some of these reissue claims are for combinations composed of fewer elements than the combinations claimed in the original. But a claim is enlarged, not diminished, by leaving out an element of a combination. *Gill* v. *Wells*, 22 Wall. 1.

On cross-examination the following testimony was given by Prof. Brackett, the expert for appellant. (*Rec.*, pp. 19 and 20):

"*Cross-Int.* 37. I wish now to call your attention to the claims of said patent No. 130,770 and of the reissue No. 9,743. Claim numbered 3 in the reissue is identically the same, excepting the omission of the letter R after 'ratchet-wheel,' as claim 3 of the original, is it not?

Ans. It is.

Cross-Int. 38. What claim, if any, in the reissue corresponds precisely with claim 1 of the original?

Ans. As I understand it, claim 5 embraces the same things as claim 1, though not in precisely the same terms, *being more fully expanded.*

Cross-Int. 39. What claim, if any, of the reissue corresponds precisely with claim 2 of the original?

Ans. Claim 4 seems to me to involve the same matters, it being remembered that claims 1 and 2 are to be read in combination.

Cross-Int. 40. Do the other claims of the reissue cover what is specifically claimed in any one of the three claims of the original?

Ans. In my opinion only in a general sense, *and for another purpose than to claim the specific mechanism involved in the apparatus.*"

Again on p. 61, Prof. Brackett says:

"*Cross-Int.* 16. Has claim 2 of the reissue patent No. 9,743 its foundation in any other claim of the original patent 130,770 than claim 1 of said original?

Ans. I do not see that it has."

The opinion of the Court, delivered by Mr. JUSTICE MATTHEWS, in *Manufacturing Co.* v. *Dover Stamping Co.*, 111 U. S., 319, a case involving the validity of a patent for egg-beaters, is especially in point. The Court says:

"We are quite satisfied that the difference between the original claim and the first claim of the re-issued patent is substantial and not verbal. The former is necessarily limited to the particular device described as a frame, with a series of cutting edges attached, in the mode designated, and capable of rotation. The latter embraces every revolving beater-frame, formed of thin, plain blades or cutters, arranged to cut through the material by their rotation. It is immaterial whether or not the latter might have been covered by the language of the specification as included in the invention. We are dealing with the claims and nothing else. And it cannot be successfully contended that the original claim implicitly contained all that is expressed in the claim of the reissued patent.

The original claim has been made broader by the reissue, so as to embrace the device used by the appellants, which was not previously an infringement. And that raises the question whether, under the circumstances disclosed by this record, the reissue is valid. To avoid this question it is, indeed, contended by the appellees, that the two claims under examination are identical; that their apparent differences are merely literal; that the meaning is the same; and this conclusion is thought to be reached, not by restraining the reissue to the language of the original, but by a process of construction, by the use of supposed implications, to expand the words of the original so as to cover everything embraced in the reissue. * * * * But, as already intimated, this position is not tenable. There is nothing in the language or recitals of the original patent, nor are there any just and reasonable inferences of which they are suscepti-

ble, which justify a construction of the claim that would embrace any device other than that described in the specifications and represented in the drawings—much less to include every mechanical arrangement which embodies a cutting edge with a revolving frame, to cut instead of break the egg material upon which it is meant to operate.

The question then recurs, what are the circumstances which affect the validity of the reissue, and how do they affect it?

They are few, but decisive. The original patent was issued July 7th, 1863. Eleven years after, in 1874, the competition of the the appellants' device became apparent and was felt. In 1875, application was made for the reissue * * * and the reissued patent was granted July 13th, 1875. Here is a delay of nearly twelve years, without the offer of an explanation or excuse, without even the suggestion of inadvertence or mistake in the original application. The only inference that be drawn is that the discovery and experience of successful competition in 1874, suggested first and led to the discovery that the original claim did not cover everything that might have been embraced, and was not broad enough to maintain the monoply desired but not secured.

This brings the case directly within the principle of *Miller* v. *Brass Company*, 104 U. S. 350, and the numerous others which have followed it, including that of *Clements* v. *Odorless Apparatus Company*, 109 U. S. 641, all of which have been decided since the interlocutory decree in this case was pronounced."

II.

The new claims of the reissue are not for the same invention which was set forth in the claims of the original patent.

This is shown conclusively not only by comparison of the claims of the reissue with those of the original, but by the testimony of Dr. Cutler, president of the company which owned the original patent when the reissue was applied for, and by the oath of Tirrell to the application.

Dr. Cutler, in the course of his direct examination as a witness in behalf of the complainant, testified as follows, *(Rec.* p. 75*)*:

"*Int.* 6. If you know with what purpose and intention application was caused to be made by the Franklin Electric Gas Lighting Company for a reissue of letters patent No. 130,770, will you please state the same?

Ans. For the reason that we were told that we had no claim for the invention of the turning of the stop-cock and lighting the gas by a single current with one wire in our 1872 patent, and for no other reason."

Tirrell's oath to the application for reissue, *(Rec.* p. 83*)* declares that his

"aforesaid letters patent are inoperative by reason of a defective specification, and that such defect consists in the *omission of claims for the different combinations* of wires, electro-magnets, armature attracted thereby, mechanism actuated by said armature, circuit-breaker, and other elements operating automatically as specified and claimed in the claims of this application."

If, as is now claimed, the invention which Tirrell really made and which he intended to claim and secure by patent No. 130,770 was the utilizing of one electric circuit, both to turn on and also to light the gas, it is remarkable that, in the long and minute description contained in the original patent, there is no such statement as that the invention consists in utilizing one electric circuit to do the work of turning on and lighting the gas which had formerly required two electric circuits; nor is there any claim for such an invention in the original patent. On the contrary, the description and claims of the original are confined to the specific mechanism shown in the drawings.

The statement in the second paragraph of the specification that "under this invention the circuit-breaker is located at the burner, and by the direct action of the current, through the magnet located at the burner, the circuit-breaker and the valve to let on or turn off the gas are both operated," etc., is equally true of the apparatus shown and described in patent No. 121,301 to Tirrell, dated November 28, 1871, excepting that in the 1871 patent the circuit-breaker is located at the auxiliary burner instead of being at the main burner.

III.

The new claims of the reissue are void, because they enlarge the claims of the original patent, and are not for the same invention originally claimed.

Powder Co. v. *Powder Works*, (Nitro-Glycerine Compounds) 98 U.S. 126, 137-139.
Ball v. *Langles*, (Oven) 102 U. S. 128, 132.
Manufacturing Co. v. *Ladd*, (Turbine Water Wheel) Id. 408, 413.
Manufacturing Co. v. *Corbin*, (Sash Lock) 103 U.S. 786.
Miller v. *Brass Company*, (Lamp) 104 U. S. 350.
James v. *Campbell*, (Cancelling Stamp) Id. 356.
Heald v. *Rice*, (Steam Boiler) Id. 737.
Bantz v. *Frantz*, (Boiler Furnace) 105 U.S. 160.
Johnson v. *Railroad Co.*, (Fasteners for Metallic Roofing) 106 U.S. 539, 547.
Wing v. *Anthony*, (Plate-Holder for Cameras) Id. 142, 147.
Hoffheins v. *Russell*, (Harvester) 107 U.S. 132.
Gage v. *Herring*, (Apparatus for cooling Meal) Id. 640.
Clements v. *Odorless Apparatus Co.*, 109 U.S. 641, 647–650.
McMurray v. *Mallory*, (Soldering Machine) 111 U.S. 97, 103.
Manufacturing Co. v. *Dover Stamping Co.*,(Egg Beater) Id. 319.
Mahn v. *Harwood*, (Base-Ball Cover) 112 U. S. 354.
Torrent Company v. *Rodgers* (Rolling Saw-Logs) Id. 659.
Coon v. *Wilson*, (Collars), 113 U. S. 268, 277.
Wollensak v. *Reiher* (Transom-Lifter), 115 U. S. 96, 99.
Eachus v. *Broomall* (Cutting Paper Boards), Id. 429, 438, 439.
White v. *Dunbar* (Preserving Shell-Fish), 119 U. S. 47, 51, 52.
Ives v. *Sargent* (Door-Bolts), Id. 652, 663.
Newton v. *Furst & Bradley Co.*, (Gang Plough), Id. 373, 384, 385.
Worden v. *Searls*, (Whip-Sockets), 121 U. S. 14, 24.
Parker & Whipple Co. v. *Yale Clock Co.*, (Clock) 123 U. S. 87, 102.
Matthews v. *Iron Clad Mfg. Co* (Soda-Water Fountain), 124 U. S. 347.
Hoskin v. *Fisher* (Hydraulic Mining Apparatus), 125 U. S. 217.
Yale Lock Co. v. *James* (Post-Office Boxes), Id. 447, 464.
Cornell v. *Weidner* (Metallic Cask-Bushings), 127 U. S. 261.
Yale Lock Co. v. *Berkshire Bank* (Time-Lock, etc.) 135 U. S. 342, 379.

IV.

The invention for which the original patent was granted is that which is set forth in the claims of that patent. These claims are clear and distinct, and their plain meaning is not to be extended by reference to the specification. On the contrary, the words "substantially as described," at the end of the first and second claims, limit those claims to the specific mechanism described in the specification.

Keystone Bridge Co. v. *Phœnix Iron Co.*, 95 U. S. 274, 278.
James v. *Campbell*, 104 U. S. 356, 370.
White v. *Dunbar*, 119 U. S. 47, 52.
Mitchell v. *Tilghman*, 19 Wall. 395.
Howe Machine Co v. *National Needle Co.*, 134 U. S. 388.

In *White* v. *Dunbar*, 119 U. S. 47, 52, Mr. JUSTICE BRADLEY said:

"Some persons seem to suppose that a claim in a patent is like a nose of wax which may be turned and twisted in any direction by merely referring to the specfication, so as to make it include something more than, or something different from, what its words express. The context may, undoubtedly, be resorted to, and often is resorted to, for the purpose of better understanding the claim; but not for the purpose of changing it and making it different from what it is. The claim is a statutory requirement, prescribed for the very purpose of making the patentee define precisely what his invention is; and it is unjust to the public, as well as an evasion of the law, to construe it in a manner different from the plain import of its terms."

V.

Whatever was not claimed in the original patent is conclusively presumed either to be old or to have been abandoned or dedicated to the public.

Miller v. *Brass Company*, 104 U. S. 350.
Mahn v. *Harwood*, 112 U. S. 354.
James v. *Campbell*, id. 356.

In *Mahn* v. *Harwood*, the Court say:

"It is clear, therefore, on the face of the patent that the only object of the re-issue was to enlarge the claims. The description was not altered in the least. The claims in the original patent were clear and explicit, one of them being substantially retained in the reissue. Nothing was altered, nothing was changed, but to multiply the claims and to make them broader. And this was done, not for the benefit of the original patentee, but for that of his assignee; and was done after the lapse of nearly four years from the granting of the original patent. The case seems to come clearly within the principles laid down in *Miller* v. *Brass Company*, 104 U. S. 350, and if we were right in the conclusions arrived at in that case, we do not see how we can sustain the patent sued on in this. The counsel for the appellant seems to be aware of this, and, in his argument, directs his efforts mainly to attack the principles there expressed, although they have been frequently reiterated in subsequent cases. We deem it proper, therefore, to say, once for all, that the views announced in *Miller* v. *Brass Company* on the subject of reissuing patents for the purpose of expanding and enlarging the claim, were deliberately expressed and are still adhered to. * * * * * *

Now, in our judgment, a patent for an invention cannot lawfully be reissued for the mere purpose of enlarging the claim, unless there has been a clear mistake inadvertently committed in the wording of the claim, and the application for a reissue is made within a reasonably short period after the original patent was granted. The granting of such reissues after the lapse of long periods of time is an abuse of the power, and is founded on a total misconception of the law. The Commissioner of Patents has evidently proceeded, in these cases, on the view that a patent may be reissued after any lapse of time, for the purpose of making a broader claim, by merely showing that the claim might have been broader than it was, and that it was inadvertently made too narrow at the time. In this we think he has been entirely in error. * * * * * * *

The taking out of a patent which has (as the law requires it to have) a specific claim, is notice to all the world, of the most public and solemn kind, that all those parts of the art, machine or manufacture set out and described in the specification and not embraced in such specific claim, are not claimed by the patentee,—at least not claimed in and by that patent. If he has a distinct patent for other parts, or has made application therefor, or has reserved the right to make such application, that is another matter, not affecting the patent in question. But so far as that patent is concerned, the claim actually made operates in law as a disclaimer of what is not claimed; and of all this the law charges the patentee with the fullest notice.

Then what is the situation? The public is notified and informed by the most solemn act on the part of the patentee, that his claim to invention is for such and such an element or combination, and for nothing more. Of course, what is not claimed is public property. The presumption is, and such is generally the fact, that what is not claimed was not invented by the patentee, but was known and used before he made his invention. But, whether so or not, his own act has made it public property if it was not so before. The patent itself, as soon as it is issued, is the evidence of this. The public has the undoubted right to use, and it is to be presumed does use, what is not specifically claimed in the patent. Every day that passes after the issue of the patent adds to the strength of this right, and increases the barrier against subsequent expansion of the claim by reissue under a pretence of inadvertence and mistake. If any such inadvertence or mistake has really occurred, it is generally easily discernable by an inspection of the patent itself; and any unreasonable delay in applying to have it corrected by a surrender and reissue is a just bar to such correction."

VI.

If the original claims did not cover the invention, the defect in the claims, if any existed, would be apparent on inspection. The unexplained delay for nearly nine years in applying for the reissue is fatal to the new claims of the reissue.

Miller v. *Brass Company*, 104 U. S. 350, 355.
Clements v. *Odorless Apparatus Co.*, 109 U. S. 641, 649.
Mahn v. *Harwood*, 112 U. S. 354, 363.
Wollensak v. *Reiher*, 115 U. S. 96, 100.
Ives v. *Sargent*, 119 U. S. 652, 662.
Hoskin v. *Fisher*, 125 U. S. 217.

In *Ives* v. *Sargent*, 119 U. S. 652, 662, this Court said:

"It is also settled that while no invariable rule can be laid down as to what is a reasonable time within which the patentee should seek for the correction of a claim which he considers too narrow, a delay of two years, by analogy to the law of public use before an application for a patent, should be construed equally favorable to the public, and that excuse for any longer delay than that should be made manifest by the special circumstances of the case. *Wollensak* v. *Reiher*, 115 U. S. 96, 100; *Mahn* v. *Harwood*, 112 U. S. 354, 363."

MR. JUSTICE MATTHEWS stated in *Wollensak* v. *Reiher*, 115 U. S. 96, 99:

"It follows from this, that if, at the date of the issue of the original patent, the patentee had been conscious of the nature and extent of his invention, an inspection of the patent, when issued, and an examination of its terms, made with that reasonable degree of care which is habitual to and expected of men, in the management of their own interests, in the ordinary affairs of life, would have immediately informed him that the patent had failed fully to cover the area of his invention. And this must be deemed to be notice to him of the fact, for the law imputes knowledge when opportunity and interest, combined with reasonable care, would necessarily impart it. Not to improve such opportunity, under the stimulus of self-interest, with reasonable diligence, constitutes laches, which in equity disables the party who seeks to revive the right which he has allowed to lie unclaimed from enforcing it to the detriment of those who have in consequence been allowed to act as though it was abandoned."

VII.

Not only was the right to a reissue forfeited by the long and unexplained delay in applying for it, but there was no such "inadvertence, accident or mistake" as would authorize a reissue with new claims.

Matthews v. *Iron Clad Manufacturing Co.*, 124 U. S. 347.
Clements v. *Odorless Apparatus Co.*, 109 U. S. 641, 649.
Mahn v. *Harwood*, 112 U. S. 354, 359.
Coon v. *Wilson*, 113 U. S. 268, 277.
Newton v. *Furst & Bradley Co.*, 119 U. S. 373, 385.

There was no error in the description of the invention, for the description is the same in the reissue; and the claims of the original patent are adequate to cover the apparatus described in the specification and shown in the drawings.

Worden v. *Searls*, 121 U. S. 14, 24.

VIII.

It cannot be successfully claimed that the second and fifth claims of the reissue are for the same invention which is set forth in the first claim or in any other claim of the original patent, and that they are only a more accurate description of that invention.

The first claim of the original patent was repeated in the application for the reissue, and, as has already been shown, it was finally abandoned by Tirrell after repeated and unsuccessful efforts to convince the Patent Office that the invention set forth in this claim was not anticipated by the earlier patents referred to by the examiner.

Nor can the second and fifth claims of the reissue be sustained on the ground that they are for the invention actually described in the original patent.

As was said by MR. JUSTICE BLATCHFORD in *Parker and Whipple Co.* v. *Yale Clock Co.*, 123 U. S., 87, 104:

> "It is urged that every one of the claims of the reissue responds to the object of making a cheap and small but satisfactory timepiece. But this statement, in the original specification, of the object of the invention in such general terms, cannot have the effect of making the reissue one for the same invention as that of the original, when it otherwise would not be. Such a general statement contained no intimation that the invention consisted in the matters covered by the first eight claims of the reissue."

IX.

Unless the first claim of the original patent is limited to a circuit-breaker located at the burner, (which limitation is now denied by complainant), the fourth claim of the reissue is for a combination of a smaller number of elements than the second claim of the original, and is therefore void for reasons before given.

Gill v. *Wells*, 22 Wall. 1.
McMurray v. *Mallory*, 111 U. S. 103.
Matthews v. *Machine Co.*, 105 U. S. 54, 57.
Hoskin v. *Fisher*, 125 U. S. 217, 222.

Litigation as to Tirrell Patents.

Two suits were brought by the Electric Gas Lighting Company in the Circuit Court of the United States for the Southern District of New York for infringement of the reissued patent No. 9,743. One of these suits was against Tillotson & Co. The opinion of the Court (Wheeler, J.) is reported in 21 Fed. Rep., 568, and is as follows:

"Wheeler J. This suit is brought upon reissued letters patent No. 9,743 granted to Jacob P. Tirrell, assignor, and dated June 7, 1881, for electrical apparatus for lighting street lamps. The original patent was No. 130.770, dated August 20, 1872. The infringement complained of was made under patent No. 230,590, dated July 27, 1880, granted to the same Jacob P. Tirrell, assignor to George F. Pinkham, for an electric gas-lighting apparatus. One of the defenses is that the reissue is not supported by the original. The specifications of the original and reissue are precisely alike. The original had three claims; for

'(1.) A circuit-breaker, located at the burner and operated automatically, substantially as described. (2.) In combination with the above, a lever adapted and arranged to open and close the stop-cock or valve of the burner, and carrying the circuit-breaker, substantially as herein described. (3.) The arms, O Q, sector wheels *f*, *n*, pins ll^2, $m\,m^2$, wires, M, N, magnet E, lever H, carrying the armature G, circuit-breaker J, and pawl, S, and the ratchet-wheel R, all combined and arranged together, and applied to a gas-burner for operation, substantially as and for the purposes set forth.'

The reissue has six claims. The first and sixth are for combinations not found, nor claimed to be, in the alleged infringing device; the third is the same in each; and the fourth in the reissue is the same as the second in the original. There is in the alleged infringement no lever to open and close the stop-cock, and carrying the circuit-breaker, to form the combination of the original second, now the fourth, claim; nor arms, sector-wheels, pins, pawl, or ratchet-wheel, to form the combination of the constant third claim. The only claims remaining, and the only ones relied upon here, are the second and fifth. They are for

'(2.) In an apparatus for lighting gas by electricity, the helix of an electro-magnet, connected at one end with the wire through which

the current of electricity is passed, and at the other end with a circuit-breaker located at the gas-burner, so arranged that the current of electricity is passed to the circuit-breaker through said magnet, attracting an armature-actuating mechanism operating automatically to turn on the gas and light the same by the effects of the primary sparks made at the tip of the burner from said magnet in the circuit.

(5.) In an apparatus for lighting gas by electricity, the combination of a wire through which a current of electricity is passed, actuating mechanism for letting on the gas, an electro-magnet electrically connected with said wire, an armature operated by said electro-magnet, mechanism actuated by said armature breaking the circuit at the burner-tip and producing there an electric spark or sparks for lighting the gas, the whole operating automatically.'

These claims do not refer to any mechanism described for turning on the gas or breaking the circuit, but are drawn to apply to any mechanism operative in the proper connection with the parts described for those purposes. When the circuit is closed, a current of electricity may be sent through the helix and around the circuit past the burner-tip. This will charge the helix with electricity so that it will attract the armature to itself. If any mechanism is attached to the armature, so that the motion of the armature will break the circuit at the burner-tip, a spark will be found [formed] there from the flowing current, but the current, if not too powerful, will cease. This will relieve the helix from the charge of electricity and the armature from its attraction, and leave the armature free to move away from the helix, and, by its motion through the mechanism, to close the circuit, when, if the supply of electricity is continued, the operation will be repeated. The motion of the armature may, by appropriate mechanism, be made to open and close the stop-cock, as well as to break and close the circuit. These claims seem to be intended and appropriate to cover this arrangement of the wires and helix in the circuit with the circuit-breaker, and with the armature moving by the force of the current, and some mechanism by which the motion of the armature will break and restore the circuit and move the stop-cock, without regard to the form of the mechanism. The parts necessary to be described are well enough described with the arrangement of the whole; the rest is left to the common knowledge of those skilled in such matters. *Loom Co.* v. *Higgins*, 105 U. S. 580. But this arrangement of these parts was not claimed anywhere in the original patent as a part of the invention. The first and second claims contained no allusion to the wires, helix, or armature; the third was for these and several other parts, *all* combined and arranged together, and applied to a gas-burner for operation, thus showing an intention to claim that particular combination of the whole. *Gage* v. *Herring*, 107 U. S. 640; *Clements* v. *Odor-*

less Apparatus Co., 109 U. S. 641. The original patent stood nearly nine years before these claims were made. The right under which the defendant operates had accrued before they were made. They cannot be upheld now, as this case, and the decisions made upon this subject, are understood. *Miller* v. *Brass Co.*, 104 U. S. 350.

Let there be a decree that these claims are invalid, and that the bill be dismissed with costs."

The other of said suits was against the Smith & Rhodes Electric Co. In this suit infringement was alleged of the fifth claim of the reissue.

Aside from copies of a few patents, the only evidence introduced by defendant in the Smith & Rhodes suit was a copy of the file-wrapper and contents in the matter of the said reissued patent. The original patent, No. 130,770, had not been introduced in evidence by either party; and, after the decision in the Tillotson suit, the defendant's attorney moved for leave to put the original patent in evidence. This motion was granted. The decision of Judge Wheeler, granting the motion, was filed December 2, 1884, in the Clerk's office of the U. S. Circuit Court for the Southern District of New York. This decision has not been published, so far as we are aware; and, as it seems to be pertinent to some of the issues in the suit at bar, we append a copy of Judge Wheeler's decision, which is as follows:

"UNITED STATES CIRCUIT COURT,
SOUTHERN DISTRICT OF NEW YORK.

ELECTRIC GAS LIGHTING CO.
vs.
SMITH & RHODES ELECTRIC CO. } *In Equity.*

The patent in question in this case is the same reissue as that in *Electric Gas Lighting Co.* vs. *Tillotson*, 21 Fed. Rep. 598. This case has now been heard on the motion of the defendant for leave to put the original patent in evidence as it was in that case. The motion is resisted on the ground that the original would not

show that the reissue is invalid, and that therefore its introduction would have no effect. The argument has been in reality, a re-argument of the question decided in that case. Upon reconsideration the same views are entertained upon this question now as then. The only claim in the original on which the claims in question in the reissue can rest, is the first. That is merely for a circuit-breaker located at the burner, and operated automatically substantially as described. Not for any machinery operating it as described, but for a circuit-breaker so located and operated. The reissue would cover the machinery producing the automatic operation; a different thing from that covered by the original. These claims are new and are made too late, nearly nine years after the original was granted. As the ground on which the motion is opposed fails, the motion should be granted, but on terms that, if the defendant finally prevails, no costs are to be taxed in its favor in this Court.

Motion granted accordingly."

After the granting of this motion and the introduction in evidence of the original patent, the Smith & Rhodes suit was argued. The opinion of the Court was announced March 16, 1885, holding the second and fifth claims of the reissue to be void, and is reported in 23 Fed. Rep., 195. There was subsequently a rehearing, but Judge Wheeler adhered to his former conclusion, without delivering any opinion for publication. An appeal was taken from the decision in the Tillotson suit, and that suit is now pending in this Court. No appeal was taken in the Smith & Rhodes suit.

In the Tillotson suit, and also in the Smith & Rhodes suit, the only witness who testified on behalf of the complainants was Park Benjamin, a well known expert, who had made a special study for several years past of the subject of electricity and electric apparatus and devices. He was examined at great length. The only evidence for the defendant in the Smith & Rhodes suit which was relied on in defence, consisted of the copy of the original patent and of the file-wrapper and contents in the matter of the reissued patent. The only material witness who testified in behalf of the defendant in the Tillotson suit was Dr. Henry Morton, president of the Stevens Institute

of Technology. By agreement of counsel, a copy of this testimony of Dr. Morton and a copy of the file-wrapper and contents in the matter of the reissue, were received as evidence in the present case on behalf of the defendant. Mr. Benjamin's testimony in the New York suits is not in evidence here, except so far as it is quoted in Dr. Morton's deposition. In place of Mr. Benjamin, complainant has called and examined Professor Cyrus F. Brackett, of the College of New Jersey, at Princeton, N. J., as an expert witness in the present suit. The only other new evidence for complainant consists of the deposition of W. C. Cutler, as to the extent of use of certain electrical apparatus, and of several patents and models of apparatus. Most of these patents were referred to in the New York suits.

The new evidence for defendant consists of the deposition of Frank L. Freeman, an expert in electrical matters, and of George F. Pinkham and Jacob P. Tirrell.

The opinion of Judge COLT in the present suit was filed December 24, 1886, and is as follows:

"COLT J. This suit is brought on the Tirrell reissue patent, dated June 7, 1881, and numbered 9,743. In *Electric Gas Lighting Co.* v. *Tillotson*, 21 Fed. Rep. 568, and in *Electric Gas Lighting Co.* v. *Smith & Rhodes Electric Co.*, 23 Fed. Rep. 195, Judge Wheeler held the second and fifth claims of the reissue to be void, on the ground that these claims were broader than those of the original patent. I have carefully considered these opinions and concur in the views therein expressed. The new evidence brought forward by complainant in this case does not tend to overthrow the conclusions of Judge Wheeler, because it is apparent, upon a comparison of the original patent with the reissue, that these claims are void under the authority of *Miller* v. *Brass Co.*, 104 U. S. 350, and subsequent cases.

The only remaining question is whether defendant infringes claim four of the reissue, which is in substance the same as claim two of the original. The claim is as follows: 'In an apparatus for lighting gas by electricity, in combination with a circuit-breaker located at the gas-burner, a lever adapted and arranged to open and close the stop-cock or valve of the burner, and carrying the circuit-breaker, substantially as herein described.' In defendant's appara-

tus, which is made after the Crockett patent, bearing date July 17, 1883, the two armatures operate to open and close the gas valve, but there is found no separate lever to open and close the valve and carrying the circuit-breaker such as is described in the Tirrell patent. The defendant's device is so different in construction and mode of operation from that described in the fourth claim that it is clear there is no infringement.

The bill must be dismissed with costs."

On the same day on which this opinion was filed, Judge Colt filed his opinion in the suit of *Boston Electric Company* v. *Fuller et al.* (reported 29 Fed. Rep. 515). The defense of this suit was assumed by the Electric Gas-Lighting Company, and the two suits were argued together. The opinion of Judge Colt in the Fuller suit is as follows:

"COLT, J. This suit is brought for infringment of the first claim of letters patent No. 230,590, granted July 27, 1880, to George F. Pinkham, assignee of Jacob P. Tirrell, for Electric Gas Lighting Apparatus. The invention relates to apparatus for lighting gas by electricity, in which the gas-cock is opened and closed by electric action upon a mechanical device connecting with the cock and a battery. The specification says:

'My present improvements consist in the employment of a horizontal swinging arm attached to the lower end of the vertical gas-cock, this arm being forked and straddling an upright bar erected upon the top of a vibrating armature disposed between two pairs of electro-magnets and caused to vibrate by the closing and opening of an electro-circuit from a suitable battery, the vibration of the armature effecting reciprocation of the lever and cock.

My invention also consists in connecting the armature with the lower end of the movable electrode or arm in such manner that as the armature moves in one direction and opens the cock it causes the movable electrode to separate from the fixed and insulated electrode, thus breaking the electric circuit and producing a spark to light the gas, while a reverse movement of the armature closes the cock and allows the movable arm to return by the stress of a spring and make contact with the fixed arm.

* * * * * * * *

It will be seen that the vibrations of the armature are of such extent and its relations to the gas-cock and movable electrode are such that the cock is opened before the spark is produced. The

purpose of this is to cause a sufficient volume of gas to issue from the burner in advance of the spark to insure its ignition by the latter.

* * * * * * * *

In the use of this device the pressure on the knob which charges the magnet H H′ should be continued for a few seconds, as this produces rapid intermittent vibrations of the movable electrode and a corresponding number of sparks, the object of this being to insure the lighting of the gas should the first spark fail to do so. In order that these continued vibrations of the movable electrode and armature may be placed without effect upon the gas-cock, I form the notch in the forked end of the lever of sufficient width to permit of the vibrations of the armature without moving such lever.'

Claim 1 is as follows:

'1. In an electric-lighting gas-burner, a magnet for turning the gas-cock by one electric impulse, combined with a fixed electrode a', and a movable electrode, c', normally in contact, and mechanism connecting the armature with the movable electrode to break the contact between a' and c' the instant after the the gas is turned on, and create a spark for ignition, substantially as described.'

In gas-burners there is a portion of the tube between the cock and the end of the tube which becomes full of air when the gas is turned off. When the gas is again turned on, a little time is required to expel the air from the burner. If only one electric spark is produced at the tip of the burner the instant the gas-cock is turned, the air would not have escaped and the gas may not be lighted. In the patented apparatus the gas-cock is opened by a single impulse, and by pressure on the button a succession of sparks is produced at the burner-tip by the intermittent vibrations of the movable electrode and the armature, and these vibrations occur without further moving of the gas-cock by reason of the notch in the forked end of the lever. In closing the gas-cock no spark is produced at the burner-tip. There is evidence that this apparatus was the first which operated successfully in house lighting, and that it has been successfully used. Now it is apparent that this apparatus was not anticipated by the Tirrell inventions of 1871 and 1872, and contained in patents 121,302 and 130,770, nor by the Cutler patent No. 220,704. None of these prior devices were so constructed that, by the action of the electric current, the gas-cock is turned by a single impulse and a succession of sparks is produced at the burner-tip without further motion of the gas-cock. I am also satisfied that this improvement over prior devices constituted invention.

The defendants' apparatus is the same in principle, though its construction differs somewhat from the plaintiff's. The magnets

have their cores parallel with the burner, while the magnets in the patent are substantially at right angles thereto; the movable electrode has a vertical movement, to break the circuit, while the movable electrode in the patent has a laterally vibrating movement; in defendant's apparatus the armature is horizontal instead of vertical, and the means for breaking the circuit are somewhat different. I am of opinion, however, that the defendants' apparatus embodies the substance of the patented invention, and that changes in the details of construction should not protect them from the charge of infringement. The fact that the main features in the patented apparatus, such as the circuit-breaker, single circuit, operating the gas-cock directly by the armature, were old, should not limit the complainant to the exact form of mechanism found in the patent. The patent covers an important improvement in the art of lighting gas by electricity, and it should receive a reasonably broad construction, and those should be held to be infringers who accomplish the same result by substantially the same or equivalent means."

In this suit a final decree was entered in favor of complainant; no appeal has been taken; and the time for appeal long since expired.

The Crockett burner, being the apparatus described and claimed in patent No. 281,345, resembles the apparatus of patent No. 230,590 in dispensing with ratchet-wheel and switching mechanism, in opening and closing the gas-cock with one electric impulse, and in employing two electro-magnets and two independent electric circuits—one for turning on and igniting the gas, and the other for turning off the gas.

It is admitted (*Rec.*, p. 27) that the exhibit referred to in Dr. Morton's testimony as the Pinkham Burner is the same as the exhibit in the present suit marked "Tirrell's 1880 Burner, Defendant's Exhibit No. 3," which last exhibit Tirrell testifies is constructed in accordance with patent No. 230,590 (*Rec.*, p. 48). See also *Morton*, p. 40, *Int.* 15, as to identity of the Pinkham burner with the burner of patent No. 230,590. As will be seen by the references made in another part of this brief, in discussing the question of infringement, the reasoning contained in Judge Wheeler's opinion in the Tillotson suit, and the testi-

mony of Dr. Morton as to the differences between the Pinkham burner and the burner described in the reissued patent, are equally applicable to the Crockett burner.

No Infringement by Defendant.

Infringement is alleged only of the second, fourth and fifth claims of the reissued patent. Even if the application for the reissue had been seasonably made, the defendant does not infringe any of these claims under any construction which can properly be put upon them. If construed to cover more than the claims of the original patent, these claims of the reissue are void.

Johnson v. *Railroad Co.*, 105 U. S. 539, 547.
Matthews v. *Iron Clad Mfg. Co.*, 124 U. S. 347.

To determine the question of infringement, in case the Court should be of opinion that these claims of the reissue have any validity, it is necessary first to decide what invention they cover, and then to ascertain by comparison whether such invention is embodied in the defendant's apparatus.

The construction to be given to the claims is limited in three ways, namely;

1. By the state of the art.

Carlton v. *Bokee*, 17 Wall. 463, 471.
Railway Co. v. *Sayles*, 97 U. S. 554, 556.
Grier v. *Wilt*, 120 U. S. 412.

2. By the specification; but, though a claim may be limited by the language used in the description, it cannot be enlarged.

Railroad Co. v. *Mellon*, 104 U. S. 112, 118.
Keystone Bridge Co. v. *Phœnix Iron Co.*, 95 U. S. 274, 278.
Western Electric Co. v. *Ansonia Co.*, 114 U. S. 447, 452.
Yale Lock Co. v. *Greenleaf*, 117 U. S. 554, 559.

3. By the proceedings in the Patent Office and by the patentee's erasure, limitation or qualification of claims to meet objections made by the Office.

Cartridge Co. v. *Cartridge Co.*, 112 U. S. 624.
Sargent v. *Hall Safe and Lock Co.*, 114 U. S. 63, 86.
Dodds v. *Stoddard*, 17 Fed. Rep. 645.
Keystone Bridge Co., v. *Iron Co.*, 95 U. S. 274, 278.
Sutter v. *Robinson*, 119 U. S. 530, 541.
Boland v. *Thompson*, 26 Fed. Rep. 633.
Roemer v. *Peddie*, 132 U. S. 313, 317.
Crawford v. *Heysinger*, 123 U. S. 589, 606.
Yale Lock Co. v. *James*, 125 U. S. 447.
Phœnix Caster Co. v. *Spiegel*, 133 U. S. 360.
Yale Lock Co. v. *Berkshire Bank*, 135 U. S. 342.
Dobson v. *Lees*, 137 U. S. 259.

As the reissued patent is for a combination of old elements, there can be no infringement without use of all of the elements of the patented combination, whether all of such elements are specified in the claim, or whether some of them are made a necessary part of the patented combination by the description; and any element which the patentee has thus made a part of his combination, the Court must hold to be material.

In the case just cited, which was a suit on patents relating to improvements in scroll and band-sawing machinery, Mr. JUSTICE BLATCHFORD, speaking for the Court, said:

"The claims of the patents sued on in this case are claims for combinations. In such a claim, if the patentee specifies any element as entering into the combination, either directly by the language of the claim, or by such a reference to the descriptive part of the specification as carries such element into the claim, he makes such element material to the combination, and the court cannot declare it to be immaterial. It is his privilege to make his own claim, and his privilege to restrict it. If it be a claim to a combination, and be restricted to specified elements, all must be regarded as material, leaving open only the question whether an omitted part is supplied by an equivalent device or instrumentality. *Water Meter Co.* v. *Desper*, 101 U. S. 332. *Gage* v. *Herring*, 107 U. S. 640."

In view of the familiar principles to which reference has just been made, what construction is admissible of claims 2, 4 and 5 of the reissued patent?

From what has already been said (p. 8 *ante*), as to the state of the art, it appears that, prior to 1857, apparatus had been constructed for turning on and lighting gas by electricity, and that when Tirrell made the invention for which patent No. 130,770 was granted to him, a great many patents had been granted for automatic electric gas-lighting apparatus. Tirrell's 1872 patent is not, therefore, a primary patent. The apparatus of this patent was an outgrowth from his 1871 patents, and these, in turn, owed their origin to Bean's inventions.

This is, then, a case where it is peculiarly proper that the claims under consideration should be restricted to the specific mechanism described and shown both in the original and in the reissued patent.

Although relating to a primary patent, the language of Mr. CHIEF JUSTICE WAITE in *Wicke* v. *Ostrum*, 103 U. S. pp. 468–470, is in point. The suit was brought for infringement of a patent for a box-nailing machine. The Chief Justice said:

"To make the claims of his patent intelligible, they must be read in connection with the specifications to which they relate, and in this way it becomes apparent that the object of the inventor was to secure a patent for a new combination of old elements. Grooved spring jaws were confessedly very old. So were rods of iron with curvilinear projections, like those called plungers, and cams, of almost any shape, and treadles, and levers, and adjustable carriages, tables, and slides. The use of these things separately could not be patented, but the combination of them so as to produce a machine, useful for driving nails, was new. This the inventor might claim, and, so far as anything appears, he was entitled to a patent for the employment of spring jaws in the combination and for the purposes described in his specifications; for the combination of his peculiarly shaped plungers with spring jaws for the purpose of such a machine; for the use of the cam he described in combination with the gate and treadle to drive his machine; and for the adjustable carriage, table, and slide when used on such a machine is his.

He was entitled also to the benefit of all the mechanical equivalents of his several elements, known at the time of his invention, if used in the same combination.

As has already been seen, Wicke made an upright machine. For such a machine the combination of all his several elements was necessary. If any one, or its mechanical equivalent, was left out, an upright machine like his could not be operated successfully. A combination of other elements, not the equivalents of his, would be a different machine, and consequently not an infringement.

From the evidence it is clear he was the first to put into practical use the idea of driving more than one nail at the same time in the manufacture of boxes by the use of machinery. The idea he could not patent, but his contrivance to make it practically useful he could. By his patent he appropriated to himself only so much of the field of invention which his idea embraced as was covered by the machine described in his specification and claimed in his application.

The defendant conceived the idea of driving nails horizontally instead of vertically, and made a machine for that purpose, which he patented. He does not use the spring jaws or the peculiar shaped plungers of the Wicke machine, because he does not need them. As his object is to drive the nails horizontally, they can be laid in a groove and held there by gravity until forced into the board. Having no spring jaws to be opened, he need not shape his plunger or driver so as to effect that object. He thus has been enabled to dispense with two elements of Wicke's combination, in the absence of which that machine could not be successfully worked. Neither has he substituted any mechanical equivalent for what he has thus put aside. By changing the form of the machine and the manner of its operation, he has no need of any such contrivances. He may use the equivalent of one-half of the spring jaw of Wicke's machine, but he does not want the other half, or any thing else in its place, as the nail will lie where it is put until driven into the board. He accomplishes by natural causes what Wicke required a mechanical contrivance to do. His machine will not do the work of Wicke's, that is to say, drive a nail vertically, nor will Wicke's do that of his, and drive horizontally. The truth is, the two machines are entirely unlike, and while they both drive more nails than one at the same time, they do it in different ways. That of Wicke's, operating vertically, requires all the elements of his combination, while that of the defendant, doing its work in another way, is made by leaving out two elements which are indispensable to Wicke."

The invention shown and described in the reissue patent, as expressly stated in the specification, "relates to that class of

electrical apparatus for lighting street lamps in which the current is successfully thrown into the magnet at each burner, one after another; and under this invention the circuit-breaker is located at the burner, and, by the direct action of the current through the magnet located at the burner, the circuit-breaker and the valve to let on and turn off the gas are both operated, and the current, after the opening or closing, as the case may be, of the valve to one burner, is completely cut off from the magnet of such burner and thrown into the magnet of the next burner, and so on."

The switching mechanism, for automatically shunting the electric current to the next burner or to ground after the gas is turned on, is not only fully described in the specification, but it is absolutely essential to the operation of this apparatus. The following testimony of Tirrell is significant (p. 48):

"*Int.* 13. In the automatic lighting of street-lamps by electricity, is or is not switching mechanism essential in any practical apparatus?

Ans. It is so in my judgment. I consider it absolutely necessary."

Very little use of automatic electric gas-lighting apparatus, except for lighting street lamps, had been made until about 1878. (*Tirrell*, p. 48; *Pinkham*, p. 52; *Cutler*, pp. 74, 76.) Tirrell used switching mechanism in his two 1871 patents, and in patents Nos. 184,807 and 206,057, granted respectively in 1876 and 1878; and switching mechanism is necessary in all automatic "ratchet-wheel" electric gas-lighting apparatus.

There is no suggestion in the claims or description of the original patent that Tirrell's invention comprised anything else than the specific mechanism illustrated in the drawing of the patent. The application for the patents numbered 184,807 and 206,057 and the granting of these patents prove conclusively that both Tirrell and the Patent Office authorities understood that the 1872 patent was for only the mechanism shown and described in it. Even if Tirrell were the first to invent an electric gas-lighting apparatus in which one magnet and two wires

were utilized for doing work which had theretofore required a larger number of magnets and wires, he did not claim any such invention, nor did he state anywhere in his specification that he had made any such invention. If he had considered that this feature was of any importance, except as embodied in the particular apparatus illustrated in the drawings of the patent, how remarkable that the omission to claim it went unnoticed for nearly nine years, and especially in view of the patents granted to him in 1876 and 1878!

Both from the state of the art as disclosed by the patents in evidence and by the testimony of all of the witnesses, and from the specification and claims of the original patent No. 130,770, the claims of the reissue must be limited to the specific device of patent 130,770. In *Carlton* v. *Bokee*, 17 Wall. 417, where a single claim of the original patent for an improvement in lamps had been expanded into seven claims in the reissue, the Court said:

"So that the [first] claim is reduced to the same thing which was claimed in the original patent. The same may be said of the second and third claims. If they mean anything more than the claim in the original patent, they are void. Being identical with that, they are needlessly multiplied, and by exhibiting a seeming of claims to which Reichmann was not entitled, they are calculated to confuse and mislead. We think it proper to reiterate our disapprobation of these ingenious attempts to expand a simple invention of a distinct device into an all-embracing claim, calculated by its wide generalization and ambiguous language to discourage further invention in the same department of industry and to cover antecedent inventions. Without deciding that a repetition of substantially the same claim in different words will vitiate a patent, we hold that where a specification by ambiguity and a needless multiplication of nebulous claims is calculated to deceive and mislead the public, the patent is void."

That these claims of the reissued patent cannot be construed as covering anything more than the specific mechanism described in the original patent, is also shown by the proceedings in the Patent Office upon the application for reissue. See Defendant's Exhibit Reissue File (*Rec.*, pp. 77–88).

It is unnecessary to add much to what has already been said under the heading "History of the Reissue," pp. 16-23, *ante*. Examination of the "Reissue File" will show that the statements made under that heading are well founded.

When the examiner wrote Tirrell under date of April 5, 1881 (p. 86): "There being but a single magnet and a single armature shown, applicant cannot pluralize these terms as he has done in his amended first claim;" and when Tirrell thereupon erased that claim, it operated as a disclaimer forever binding on him and on his assigns that his invention covered anything more than the specific mechanism described and shown in the specifications and drawings of the patent. *Yale Lock Co.* v. *Berkshire Bank*, 135 U. S. 342, 379; *Sutter* v. *Robinson*, 119 U. S. 530, 541.

The fifth claim in the application for reissue is as follows:

"In an apparatus for lighting gas by electricity, a circuit-breaker located at the burner and operated automatically, substantially as described." With the exception of the first eight words, which are immaterial, this is identical with the first claim of the original patent. See the history of this claim (pp. 21-23, *ante*), and its final erasure by Tirrell (*Rec.*, p. 87).

By this erasure, and in accordance with the rule established by the decisions last cited above, and on p. 44, *ante*, Tirrell and his assigns conceded that the first claim of the original patent is void, and they are bound by that concession.

The complainant's expert, Prof. Brackett, testifies (*Record*, pp. 19 *et seq.*) that the second and fifth claims of the reissue embrace the same elements and no other elements than the first claim of the original patent. This is substantially the complainant's contention now, and that the reissue was entirely unnecessary. But as Tirrell erased this first claim of the original from his reissue application in which he has repeated it, the present second and fifth claims of the reissue must go with it.

Dr. Morton (pp. 28-30) and Mr. Freeman (pp. 64-65) well describe the invention set forth in Tirrell's reissued patent; and their testimony makes it perfectly clear that the invention must be limited to the specific device described in the patent.

Under the most liberal construction permissible, the claims of the reissue must be limited to the specific mechanism described and shown in the original patent. As is abundantly proved, a vital part of the device thus shown and described is the switching mechanism. Without it, the apparatus would be incapable of practical use; for there would be no means of accurately governing the rotation of the gas-cock, so as to have the gas fully turned on or off, at the will of the operator.

Limiting the claims of the reissue to the specific mechanism described in the reissued patent, it needs only a casual examination to show that defendant's burner does not infringe. Conceding to complainant all the equivalents to which even a shadow of claim can be made, the defendant does not infringe.

To constitute infringement of a machine-patent for a combination of old elements, the infringing apparatus must contain the combination of all those elements, operating in substantially the same way to produce the same results. *Rowell* v. *Lindsay* (Cultivator Patent), 113 U. S. 97, and cases cited.

It is admitted (*Record*, p. 27) that the burner referred to in Dr. Morton's testimony as "Exhibit Pinkham Burner," and which was the alleged infringing apparatus in the Tillotson suit, is like the exhibit in the present suit which is marked "Tirrell's 1880 Burner, Defendant's Exhibit No. 3." On comparing the exhibit last named with the alleged infringing exhibit in the suit at bar, being the one marked "Complainant's Exhibit, Defendant's Burner," and reading the testimony of Mr. Freeman, (*Record*, pp. 66-68), it will be found that there exist the same substantial differences of construction and operation between Defendant's Burner and the invention of reissued patent No. 9,743, which are pointed out by Dr.

Morton (*Rec.* pp. 31 *et seq.*) as existing between said invention and the Pinkham Burner.

Briefly stated, the invention of the reissue patent No. 9,743 consists of a combination of old elements which are specified in claim 3 of the original patent. These elements, of which the switching mechanism forms part, are all required for the successful operation of the device described in the original and in the reissued patent as Tirrell's invention. Under this invention a ratchet-wheel attached to the spindle of the gas-valve is rotated always in the same direction by mechanism which is put in operation by the electric current. The movement of the ratchet-wheel is a "step-by-step" motion, and is always in the same direction whether the gas is to be turned on or off. Means must be employed to stop the movement of the ratchet-wheel instantly when the gas is either fully turned on or off, as may be desired. This is accomplished by the switching mechanism. At every revolution of the ratchet-wheel a single tooth, a spark is produced by the separation of the electrodes near the burner-tip, whether the gas is being turned on or off. The apparatus was expressly designed for lighting street-lamps, and that is stated in the patent to be its purpose. It may be used for a single lamp, it is true, by modifying the construction so that the switching mechanism, after the gas is turned on, will shift the electric current so as to send it to ground or to the battery, instead of to the next burner; but switching mechanism is still indispensable.

The defendant's burner was not only not intended to light a series of lamps, but it is absolutely incapable of such use. It opens the gas-valve by a single impulse, and no spark is produced until the gas-valve is fully opened. It also closes the gas-valve by a single impulse. It has no switching mechanism, nor any equivalent for such switching mechanism, nor any ratchet-wheel and pawl, nor any lever carrying the circuit-breaker. It has two magnets, two armatures, and two electric

circuits. Neither of the magnets has any connection with the other. One is used solely for turning on and lighting the gas; the other solely for extinguishing it, and in turning off the gas no spark is produced.

The language of claim 4 of the reissue is literally true of the apparatus described in the reissued patent. That apparatus has, in combination, a circuit-breaker located at the burner, a lever adapted and arranged to open and close the valve of the burner, and said lever carrying the circuit-breaker. This lever is entirely distinct from the armature, and the circuit-breaker is firmly connected with the lever at all times.

Defendant's burner has no lever distinct from the armature; and even if the armature which is used in turning on the gas be considered as a lever, it in no sense "carries" the circuit-breaker, nor is it adapted to both open and close the gas-valve. The armature which operates to close the gas-valve is never in combination with the circuit-breaker, and has no connection with it at any time.

The two apparatuses are widely different both in construction and in mode of operation, as pointed out by Mr. Freeman (*Rec.*, pp. 67–69.)

Apparatus like that shown in the drawing of the reissued patent No. 9,743, has not been manufactured for many years. (*Cutler*, p. 74; *Tirrell*, p. 48; *Pinkham*, p. 53.) It was never used to any extent and it did not work well. It would have been remarkable if it had worked well; for it is made up of many delicate parts which require to be nicely adjusted, and if any one of these parts is out of adjustment with the others, the apparatus will cease to be effective. Tirrell says (pp. 47, 48) that this apparatus was used only for a short time in Chelsea, and that its use was long since abandoned. In trying to remedy its defects, Tirrell made the device for which he obtained patent No. 184,807, but this apparatus was used only to a very limited extent, and it, too, was long ago abandoned.

As to the two exhibits offered in evidence on p. 77 and marked "Complainants' Regular Burner No. 1" and "No. 2," it is to be noted that there is no evidence to show what patented devices these exhibits embody, nor whether burners like these have ever been used for gas-lighting.

NO INVENTION IN TIRRELL'S 1872 PATENT.

In every apparatus for automatically lighting gas there must exist, as parts of the same, at least three elements: a battery wire, a magnet and an armature; the battery wire is for conducting the electric current, the magnet and armature for operating the gas-valve and for lighting the gas.

At the date of the Tirrell invention of 1872 there were three common and well-known ways of lighting gas by electricity; by the use of an incandescent wire; by the use of rigid electrodes, the electric spark jumping from one to the other; and by the use of movable electrodes, the electric spark being formed by the separation of the electrodes.

Dep. Brackett, Int. 6, p. 11.

There were also two common and well-known ways of letting on the gas by electricity; the gradual opening of the valve by means of a ratchet-wheel and pawl, and the immediate opening of the valve by a single movement of the armature to the magnet.

Dep. Brackett, Int. 6, p. 11.

It was old at the date of Tirrell's invention of 1872, to employ one and the same electric current for letting on the gas and igniting it.

This is shown in patents to Frost and Lawrence, 49,254, August 8, 1865; W. W. Hopkins, 22,952, February 15, 1859.

In each of these patents the ignition of the gas is shown to be accomplished by an incandescent wire, and the gas turned on by a single electric impulse.

This is also shown in patent to Frank Bean, 73,868, January 28, 1868.

In this latter patent, however, the ignition of the gas is shown to be caused by a jump-spark and the gas turned on by a ratchet-wheel and pawl.

It was old to employ one and the same electric current in connection with a magnet at the burner to separate the electrodes at the burner-tip and furnish sparks for the ignition of the gas.

This is shown in the patent to Morris & Reid, No. 101,491, April 5, 1870.

In this patent there was shown a separate circuit for turning the gas-valve.

It was old to employ one and the same electric current in connection with a magnet at the burner to turn the gas-valve and separate the electrodes at the burner tip, for furnishing sparks for the ignition of the gas.

This is shown in patents to J. P. Tirrell, No. 121,301, November 28, 1871; and No. 121,302, November 28, 1871.

In these patents there was shown a separate current for furnishing the sparks.

It was old to employ mechanism which automatically switched the current of electricity to the next burner after it had performed its work at the first burner.

This is shown in patents to Morris & Reid, 101, 491, April 5, 1870, and E. E. Bean, No. 90,629, June 1, 1869.

In the Morris & Reid patent one current separated the electrodes and ignited the gas and another turned the gas-valve; each current was then automatically switched to the next burner.

In the Bean patent there was but one current to turn the gas-valve and to ignite the gas, and by automatic mechanism when this was accomplished the current of electricity was passed to the next burner.

It appears, therefore, that, at the date of Tirrell's supposed invention set forth in his 1872 patent, "it was old to use an "electro-magnet connected at one end with a wire through "which the current of electricity is passed, and at the other "end with a circuit-breaker located at the gas-burner, and so "arranged that said circuit-breaker acting upon and with said "magnet, operates a mechanism for turning on or off the gas "and shifting the circuit to the next lamp in series, and at the "same time connecting the said electro-magnet and circuit-"breaker with another wire, through which a current of elec-"tricity may be passed to reverse the previous operation of "turning on or off when it is desired so to do. It was also old "to cause the interruption producing the spark which ignited "the gas, by means of the magnet which turned the gas on."

Dep. Morton, Int. 4, p. 29.

Dr. Morton was asked in reference to the Morris and Reid patent, in which two circuits are shown—one for turning on the gas and the other for lighting it—how much change would be required to substitute one circuit for the two circuits in the apparatus of that patent, and he replied:

"I think a very slight change only would be necessary to "secure the difference in arrangement of circuit mentioned in "your question. In other words, if the connecting wires were "so changed that the current after passing through the magnet "B, passed through magnet C, and if at the same time the lock-"ing device were omitted, the apparatus would operate both "the turning on and lighting by the same circuit. Such a "substitution of a single circuit for two circuits in doing the "same thing was and is common in the art pertaining to such "matters, as in the case of various printing telegraphs, in some "of which two, and in others one, circuits accomplish the "same result."

Dep. Morton, Int. 16, p. 40.